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AN EXPLANATION OF

Decimal Coinage

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The Metric System

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Weights & Measures

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BY

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PREFACE.

A STATEMENT of the cause which led to the writing of this book may perhaps help the reader to understand its arguments and conclusions.

By nature fond of mathematics, and having, when a young man, lived for a considerable period in Paris and later in life for several years in the United States, I have long been familiar with the actual working of decimal coinage and the metric system. My knowledge, however, was *superficial*, because I had paid little heed to the only part of the subject that really requires much attention—the best way of meeting the difficulty, confusion and expense of introducing those systems into this country with its vast array of weights-and-measures tables; its money reckoning in pounds, shillings, pence and farthings; and the intricate ratios of our units to the metric ones.

Decimal systems have two sides—an *easy* side (the arithmetical) and a *difficult* side (the practical). This fact cannot be too carefully borne in mind. Arithmetically and mathematically, decimal systems are extremely simple. They require for their understanding no knowledge whatever of mathematics, and of arithmetic very little beyond an acquaintance with its first four rules. A moment's reflection will show that this must be so; for, otherwise, how could such systems form the basis of the reckoning, weighing and measuring of a large portion of mankind? On the other hand, viewed in regard to their compulsory adoption throughout the length and breadth of the country, the question is so difficult, far-reaching and important that it is essentially a subject to be dealt with by the Government of the day, and not by private legislation.

This double aspect of the subject is unfortunate, and it produces a threefold evil.

1. A large number of people, hearing of Royal Commissions, Select Committees, &c., and thinking special study of and aptitude for mathematics necessary for understanding the question, remain in total ignorance of it, and so constitute a huge dead weight against all progress.

2. Others, finding the matter very easy from the arithmetical point of view, rush to the conclusion that its introduction is the simplest thing in the world, and give no thought to the practical difficulties which underlie it.

3.   The subject, being so easy arithmetically speaking, books about it abound.   These for the most part err by too much copiousness, in fact, they make a mountain of a molehill, and thus help to spread the delusion that mathematical knowledge and ability are indispensable for its comprehension.

Recurring to myself, on becoming more than 13 years ago the Chairman of the Weights and Measures Committee of the Herefordshire County Council, my mind was naturally more attracted to the subject than it had been before.   Giving it particular study, the value of the Metric System stood out in bolder and bolder relief, while larger and larger also loomed the practical difficulties of its introduction.   I clearly realised the seriousness of the impediments in its way; they, nevertheless, appeared to me to be surmountable, and the gain so great that they must and would be surmounted.   Turning, however, to the sister subject—Decimal Coinage—the Pound-and-mil scheme confronted me. That damped my ardour, because I perceived the difficulties of that system to be so formidable that this generation was not likely to see them overcome.   So I became a strong advocate of decimal coinage in *theory*, but in *practice* (?).   At the same time the Metric System without decimal coinage seemed to me to be a lame and impotent conclusion without historical parallel.   Having thus come to a fence which I could not clear, I dropped the subject until some 18 months ago, when the Norms-and-pence system suddenly occurred to me.*   At once all difficulties vanished as if by magic.   Combined with the method of adoption hereinafter explained, the introduction of decimal coinage became, in my eyes, not only feasible but EASY.   Whilst, therefore, the chief object of this book is to demonstrate that fact, I have also thought it desirable to deal with the whole subject and to state the conclusions at which I have arrived as to what should be the course of legislation upon this most important question.

EDWYN ANTHONY.

* *This scheme, though the fact was unknown to me at the time, was touched on by some of the witnesses before the 1856 Royal Commission.*

INTRODUCTION.

EVERY phase of a subject, considered with the aim of framing definite laws in regard to it, usually affects more than one practical consequence. For that reason, each chapter of this book, though in general confined to one definite part of the subject, usually influences more than one of the conclusions reached. Hence an enunciation, by way of introduction, of the several propositions which the book, taken as a whole, enforces, will conduce to a clearer apprehension of the facts and arguments it contains.

PROPOSITION 1. Decimal coinage can be introduced quickly and easily by issuing one new gold and one new silver coin, and without withdrawing any of the coins at present in circulation.

PROPOSITION 2. The Norms-pence system of decimal coinage does not affect prices in the least degree, and would not cause appreciable trouble, confusion, or expense to the public. If desired, the sovereign may continue in circulation for ever.

PROPOSITION 3. The Norms-pence system is extremely simple and easy to learn ; in fact, in order to apply it to all ordinary business transactions, no knowledge of decimals is required, and it is fundamentally identical with the system in use throughout nearly the whole of the civilised world.

PROPOSITION 4. Decimal Coinage should precede the introduction of the metric, or other decimal system, of weights and measures.

PROPOSITION 5. The Metric System ought not to be introduced into the United Kingdom except by international agreement with our Colonies and the United States.

PROPOSITION 6. Decimalisation of our weights and measures can be attained without alteration of our fundamental units. Its introduction is, therefore, a far easier task, and very much less dependent on international action, than that of the Metric System.

PROPOSITION 7. Decimal weights and measures are nearer to the Metric System than our present Imperial system. Their use would shorten arithmetical calculations and facilitate international trade.

PROPOSITION 8. The subject is so difficult, important and far-reaching, that it must be dealt with by the Government of the day, or not at all.

PROPOSITION 9. The problem can be satisfactorily solved only by a gradual piecemeal method of treatment, and by the creation of special machinery for the purpose.

I believe that, apart from controversial matters, this book contains much information which will prove both interesting and instructive to those who have not made a particular study of decimal coinage, weights and measures. To all readers I recommend the Extracts contained in Chapter IV., as giving a fair insight into various aspects of the question.

Decimal Arithmetic (Chapter IX.) has been written for those readers who may happen to be entirely unacquainted with Decimals. And Decimal Reckoning (Chapter X.) contains some considerations, supplementary to Chapter V., on the decimalisation of our weights and measures.

I may add that the Draft Bill (Chapter VII.), the Manual of Decimal Coinage (Chapter VIII.), and many of the arguments in this book were submitted, substantially as they stand, to the Prime Minister in April, 1903.

CHAPTER I.
DECIMAL COINAGE.

NORMS AND PENCE SYSTEM.

This system is simplicity itself.

Let a gold coin, called a *Norm*, value 100 pence, and a silver coin, called an *Arg*, value 10 pence, be issued*. We thus have :—

10 Pence = 1 Arg ; 10 Args = 1 Norm.

Let all accounts be kept in *Norms and Pence*.

Thus N35.42 would represent 35 Norms and 42 pence, or it may be regarded as 35.42 Norms (*i.e.*, as a decimal). Such a sum might be paid away by giving 35 Norms, 4 Args, and 2 pence. In decimal coinage countries, while coins of several denominations are in use, and most conveniently so, for paying and receiving sums of money, only two denominations of coins are spoken of in matters of account. For instance, accounts in France are kept in *francs and centimes*, though various other coins are in circulation (sous, five-franc pieces, ten and 20 franc gold pieces, &c.), In the United States, *dollars and cents* take their place, 5, 10, and 20 dollar gold coins, and 10 cent., quarter, and half dollar silver coins, &c., being also used. In this country it would be *Norms and Pence.*

The Norms-and-Pence system can be introduced into this kingdom without appreciable cost, trouble, confusion, or inconvenience of any kind to the public. New ledgers, or other account books, would not even be needed. It leaves prices absolutely untouched, and the penny, halfpenny, and farthing precisely as they are. The value of the pound sterling remains exactly as it is, and the sovereign need never be withdrawn from circulation, nor any other existing coins. They may continue to be used side by side with Norms and Args. After a time it would probably be convenient to issue other coins (Two-Norm, Half-Arg, Two-Arg, and Five-Arg), as the demand for some of the old coins ceased. This fate would perhaps first befall the half-sovereign, the florin, and the four-shilling piece. The sovereign would very possibly for a long time be retained for use abroad, and for other purposes. Any number of pounds, ending with 0 or 5 (since 5 Pounds = 12 Norms) is an exact number of Norms ; and, whenever desired, sums of money could continue to be expressed in pounds. If there be any peculiar virtue in the coin called a sovereign, which some people suppose there

* *We have made up the word " Norm " from norma (a standard), and " Arg " from argentum (silver). Very possibly more appropriate names can be chosen.*

is, it can abide with us for ever.   In the writer's opinion, however, that coin would become gradually and almost insensibly disused.

Whatever system is introduced, there must be a transition state. With the Norms-pence system that state would occasion neither trouble nor confusion. Experience would gradually disclose which of the old coins were no longer convenient, and they would in time drop out of circulation. Others might continue to be useful, and, if so, they would remain. The sovereign might be among them ; and, if the opinion be held that in some mysterious way, the retention of the sovereign is beneficial, even though people find no need for it, the end might be attained by limiting the amount (say to five pounds) for which Norms should be a legal tender.

A gold coin of the value of a Norm (the writer possesses one) has been for a long time coined by our Mint, for use in Newfoundland, and it is still occasionally coined. This coin is smaller than the half sovereign.* I would suggest that, keeping of course the amount of gold in it the same (i.e. 5–12ths of that in the sovereign), the Norm should contain a greater weight of alloy. A harder, more durable, and altogether more serviceable coin would thus be obtained, and of a convenient size, say, a little larger than the half-sovereign.

The present gold coins are too soft, and consequently wear away quickly. The tendency has been uniformly towards making them harder ; and if any country had to start its coinage afresh, there can be little question but that the amount of alloy would be increased. The standard of fineness—994.8 parts out of a thousand gold, and only 5.2 alloy was introduced into England in the year 1343. This standard was practically pure gold. In the year 1526, the less fine standard of 916.6 gold and 83.4 alloy was adopted by us, the standard of the year 1343 being finally abandoned in 1637. The still less fine standard of 900 parts gold to 100 parts alloy was adopted in France in the year 1794, and has been subsequently adopted by other countries. These two standards are now those most commonly used, the English standard (11–12ths gold) being employed by Russia, Portugal, India, and Turkey, and the French standard (9–10ths gold) by most other countries. The latter standard is harder and wears better than the former.†

* The French ten-franc gold piece is of slightly less value than the Norm.

† These particulars are taken from " The Metallurgy of Gold " (4th Edition, 1902) by T. Kirke Rose, D.Sc., Assistant Assayer of the Royal Mint, &c.

Mr. Thomas Turner, M.Sc., Professor of Metallurgy in the Birmingham University, in answer to my inquiries, kindly informed me that "an 18 or 15 carat gold coin could be made with exactly the same colour as the present 22 carat sovereign. It is merely a question of the proportion of copper and silver present in the alloy. The difference in density would not be so great as to permit the general public to appreciate any change in composition." Again, Professor Turner writes: "I see no reason why a Norm should not be made of either 15 or 18 carat gold if desired, and be a good hard coin either of the same colour as the present 22 carat sovereign, or different if desired,"

I conclude, therefore, that a gold Norm could be coined which would be somewhat larger than the half-sovereign, and which would wear much longer than the sovereign. Hence a very slight subsidiary advantage of the introduction of the Norms-pence system would be that the gold coins used would last longer than the present coins. That the loss of weight by wear of gold coins is considerable, the following extract from the article "Mint" in the *Encyclopædia Britannica* (9th Edition, page 484) makes abundantly clear: "Taking the gold circulation at £100,000,000, of which about 50 per cent. is light, it is estimated that the amount to be recoined cannot be less than £50,000,000, on which the loss from deficiency of gold, both in weight and fineness, must be reckoned at about £650,000, independent of the expenses of recoinage."*

The Norms-pence system bears as convenient a relation as can be chosen to the decimal systems of other countries. The standards of these are neither all the same, nor, when they differ, exactly commensurable with one another. For example, the par value of the *franc* (countries of the Latin Union) is about 9½d. ; of the *dollar* (United States) about 4s. 1½d.,; of the *mark* (Germany) about 11¾d. ; and of the *krone* (Norway, Sweden, and Denmark) about 13d. Moreover, the

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* *Under the Coinage Act, 1870, the loss on light gold fell upon the public. The Act of 1889 (which was followed by supplementary ones in 1891 and 1893) was passed for the withdrawal of light coins, and transferred the expense to the Mint. The cost of this withdrawal for the 4 years, 1892-5, seems to have been about £500,000. The 26th Annual Report (1895) of the Deputy Master of the Mint states that the restoration had been practically completed, and that the normal annual expense of maintaining the gold currency at its then high degree of excellence would be about £30,000 a year. I am officially informed that "the Report for 1903 to be issued next month will probably contain the result of more recent enquiries."*

actual rates of exchange constantly fluctuate within narrow limits. Hence the advantage of choosing a standard identical with any existing one would be extremely small, while it would introduce the fatal flaw of causing dislocation in prices. The adoption of the Norms-pence scheme would enormously reduce the labour of book-keeping, shorten the time spent in learning arithmetic at school, facilitate international trading, and form the stepping stone to the introduction of decimal weights and measures, of which it is the natural forerunner.

Chapter VIII. contains a methodical explanation of the Norms-pence scheme. It is written on the lines on which I think an official manual should be prepared by the Government, and issued for use by the public and in elementary public schools I may, however, say here, what I repeat further on, that no knowledge of decimals is required in order to enable the general public to transact their every-day affairs on the Norms-pence system. Further, since the penny remains the same, people would drop even more easily into Norms-and-pence than they do, when they go to America, into dollars and cents. The almost absurd simplicity of a two-denominational decimal reckoning— i.e., of the one universally used—all those who have sojourned abroad, even for a brief time, do not need to be told.

It should be added that, by taking a halfpenny instead of a penny, and, for standard, a coin of the value of 100 halfpence instead of 100 pence, a system would result which is simple, and which would leave prices untouched. Such a system, compared to the Pound-mil scheme, is as light to darkness ; but Norms-and-pence are to be preferred, first, because it is more convenient to reckon in pence than half-pence ; and secondly, because it would be impracticable to produce a satisfactory gold coin of so small a value as four shillings and twopence.

It has also been proposed to reckon everything in terms of ten-pence and pence.

POUNDS-AND-MIL-SCHEME.

In this system :—
10 mils = 1 cent. ; 10 cents = 1 florin ; 10 florins = 1 pound, so that
1000 mils = 1 pound.

This scheme can only be described as atrocious. A serious objection to it is that the mil, being less than a farthing, is inconveniently small. Decimal accounts, as before remarked, are kept with two denominations only. The proposers of this plan seem to have been oblivious of that

fact, and to have intended accounts to be kept much after the old fashion, thus :—£15 „ 7 fl. „ 9 c. „ 6 mils. Nothing more need be said to show that the Norms-and-pence system is intrinsically superior.

The FUNDAMENTAL and INSUPERABLE objection, however, to the Pound-and-Mil plan is that MOST SINGLE ARTICLES OF SMALL VALUE COULD NO LONGER BE SOLD AT THEIR PRESENT PRICES.

For example : $\frac{1}{4}$d. = $1^1/_{24}$ Mils ; $\frac{1}{2}$d. = $2^1/_{12}$ Mils ; $\frac{3}{4}$d. = $3^1/_8$ Mils ; 1d. = $4^1/_6$ Mils ; $1\frac{1}{4}$d. = $5^5/_{24}$ Mils ; $1\frac{1}{2}$d. = $6^1/_4$ Mils ; $1\frac{3}{4}$d. = $7^7/_{24}$Mils ; 2d. = $8^1/_3$ Mils ; $2\frac{1}{4}$d. = $9^3/_8$ Mils ; $2\frac{1}{2}$d. = $10^5/_{12}$ Mils ; $2\frac{3}{4}$d. = $11^{11}/_{24}$ Mils ; 3d. = $12^1/_2$ Mils ; $3\frac{1}{4}$d. = $13^{13}/_{24}$ Mils ; $3\frac{1}{2}$d. = $14^7/_{12}$ Mils; $3\frac{3}{4}$d. = $15^5/_8$ Mils ; 4d. = $16^2/_3$ Mils ; $4\frac{1}{4}$d. = $17^{17}/_{24}$ Mils ; $4\frac{1}{2}$d. = $18^3/_4$ Mils ; $4\frac{3}{4}$d. = $19^{19}/_{24}$ Mils ; 5d. = $20^5/_6$ Mils ; $5\frac{1}{4}$d. = $21^7/_8$ Mils ; $5\frac{1}{2}$d. = $22^{11}/_{12}$ Mils ; $5\frac{3}{4}$d. = $23^{23}/_{24}$ Mils, &c.

Thus the price of all articles, sold singly at any of the above figures, would have to be raised or lowered. The enormous inconvenience of this necessity hardly needs exposition. A glance at its effect on the Newspaper Press alone brings it into sufficiently strong relief.

A HALFPENNY paper would have to be sold at 2 mils or at 3 mils, that is, its price must be reduced 4 per cent. or increased 44 per cent.

A PENNY paper would have to be sold at 4 mils or at 5 mils, that is, its price would have to be reduced 4 per cent. or increased 20 per cent.

The loss to the proprietors of newspapers would not, however, be gauged by 4 per cent. The diminution of net profit on the sale of papers, caused by the enforced reduction in price, would probably average from 12 to 15 per cent.

A vast army of low-priced articles might be marshalled in regard to which the inevitable reduction or increase of price would, on the one alternative, bring loss to the manufacturers of such articles, and on the other, inflict a loss upon the public which it would both most justly and most bitterly resent.

The 1856 Commissioners appear to have impaled themselves upon the horns of an imaginary dilemma. If the penny remain unaltered, said they, the pound must become £1 0s. 10d. If, *per contra*, the pound stay as it is, we must reduce the value of the penny. While preferring the latter plan, the evils of both so frightened them (and justly so) that they recommended the adoption of neither. Their report has without doubt greatly retarded the adoption in this country of decimal coinage, weights, and measures. One effect has been to completely sweep away the consideration of other schemes. The Arithmetics (without exception, I believe) used in elementary schools explain the pound-

and-mil scheme and no other.   Nearly all the arithmetics for the higher schools go into the pound-and-mil scheme and nothing else.   None, so far as I know, say anything about the Norms-pence system ; certainly those I have (a large number) do not.   No mention is made of it in the *Encyclopædia Britannica, 9th Edition*.   Modern works on Decimal Coinage say nothing about it.   For example, Lees on Decimal Coinage and Weights and Measures ; and McHardy on '' The Introduction of Decimal Coinage and Metric Weights and Measures,'' published in 1902, are silent concerning it.   These facts show how completely all schemes but that of the pound-and-mil have been obliterated from the public mind.   And how has the latter fared ?   In 1853 Mr. Gladstone declared against altering the value of those particular coins which are in point of fact the measures of value and the basis of the whole idea of value of the mass of the people.   Debated in 1855, the Government objected to a change which would so deeply affect the interests of the poorer classes. In 1881 Mr. Gladstone said he had no objection to the coinage in itself, but had always opposed an alteration in the penny, which must operate to the prejudice of the poorer classes, and which would affect nine-tenths of the transactions of daily life.   Mr. Chamberlain also spoke in similar terms.   Again, in 1893, a deputation from the Decimal Association was adversely received by the Chancellor of the Exchequer. Indeed, from 1859 to the present day, no Government has even coquetted with, much less taken up, the subject.   All seem to have concluded that it was good in theory, but *not* in practice.   And no wonder.   The difficulties and disadvantages attendant on a change to the Pound-and Mil System of Decimal Coinage are so FORMIDABLE THAT THE SCHEME MAY BE PRONOUNCED ALMOST IMPRACTICABLE.

Another effect of the report has been to make the advocates of decimal systems put the cart before the horse.   Despairing of the introduction of the Pound-mil scheme, they have been forced to begin at the wrong end.   The year 1868 saw a Bill for the compulsory use of the metric system discussed and rejected by the House of Commons, its second reading having been very successfully opposed by the late Mr. Beresford Hope.   In 1871 the '' Weights and Measures (Metric) Bill '' was dismissed by the House of Commons.   A most able and powerful speech against its second reading was delivered by Mr. J. C. Stevenson.   That admirable speech is well worth perusal and reproduction at the present moment, for most of Mr. Stevenson's arguments remain as cogent as they were on the day of their utterance, close on thirty-three years ago.*   Again, in 1873, a Compulsory Bill was laid before Parliament, but was not proceeded with.   And now a '' Weights and

* *Extracts therefrom will be found on page* 28.

Measures (Metric System) Bill," introduced in February of this year by Lord Belhaven and Stenton, and due, we believe, to the initiative of the Decimal Association, has, after reference to a Select Committee, passed the House of Lords. Lord Belhaven very skilfully brought into view the numerous and weighty arguments that exist in favour of the metric system, and he deserves the hearty thanks of the public for the skill, energy, and zeal which he has brought to bear upon the subject. The Bill, too, was supported by one of the greatest of living scientists, Lord Kelvin. Nevertheless, the conclusion is irresistible that decimal coinage must precede metrical weights and measures, and that the ill-timed, but otherwise praiseworthy efforts just narrated, have been caused by the Pound-and-mil bogey. That miserable creature holds the field through the report of the 1856 Royal Commission. Such reports, however, are by no means always well-founded, Commissions sometimes come to wrong conclusions. and the recommendation of the pound-mil scheme appears to be a striking exemplification of that fact*. On the other hand, if our bête noire, the Pound-mil scheme,

* *Mr. D. A. Thomas, in his paper on our foreign trade in coal, read in 1902 before the Royal Statistical Society, observes : " The rapid growth of our exports is an amusing commentary on the report of the Coal Commission of 1866. In their report, issued in 1871, the Commissioners stated that ' as regards the future exportation of coal, although a very large increase has taken place within the period embraced by the preceding table (1855-69), yet there is reason to doubt whether much further increase will take place in this direction.' The export given in the table for 1869 was 10,200,000, if we add 2,100,000 for bunkers, the total is 12,300,000. While they wrote the report, the export was advancing rapidly ; almost before the ink of the writing of the foolish prophecy was dry, the export showed (1872) an increase of 30 per cent. over that of 1869 ; it has continued to grow almost continuously since, until last year the total, exclusive of coke and patent fuel, exceeded 58,000,000 tons, or nearly fivefold that which the Commission predicted would not show much further increase. The report altogether is an extraordinary production, the more so when one bears in mind the acknowledged ability and great scientific attainments of the men who constituted the majority of the Commission."*

Again, one of the three recommendations of the Select Committee of 1895 on Weights and Measures was " That after a lapse of two years the metrical system be rendered compulsory by Act of Parliament." This Committee manifestly failed to fully perceive the difficulties of the change ; had their recommendation been rigidly turned into law, dire confusion and complaint must have arisen, accompanied very possibly by the fall of the Government.

or none, must be introduced, then the difficulties of the adoption of the metric system and of decimal coinage are so vast that the only possible step in the direction of practical progress, consists in *decimalising* without *metricising* our weights and measures, something after the manner described in Chapter V.

Chapter VII. contains by way of illustration a rough Draft of a Bill for the introduction of the Norms and Pence system of Decimal Coinage.

Allied to the Pound-mil system are two other schemes of coinage:

One of them may be called the Half-pound-mil system. 1,000 mils equal half-a-sovereign, instead of a sovereign. The mil, therefore, is half its previous size, while the penny, as before, decreases 4 per cent. in value. Dislocation of prices still takes place, but, theoretically, not to the same extent, owing to the minuteness of the mil.

The other scheme, due, we believe, to Mr. C. McL. McHardy, is called the "Combination Scheme." Four new coins would be issued—a Mil = 1 farthing (really an old coin under a new name); a Cent. = 2½d.; a Deci = 2s. 1d.; and a Val = £1 0s. 10d. Accounts would be kept in these four coins, and the old coins would gradually disappear from circulation.

CHAPTER II.

Explanation and Discussion of the Metric System.

The *unit of length* is the METRE, from which the system derives its epithet "metric." Its length is 1-10,000,000th part of the length of the quadrant of the meridian which passes through Paris.

Its equivalent in English measure (Order in Council of 19th May, 1898) is 39.370113 inches, or 3.280843 feet, or 1.0936143 yards.

For its decimal *multiples*, Greek prefixes (myria, kilo, hecto, deka) are used; and for its decimal *submultiples*, Latin ones (deci, centi, milli).

Thus, a myriamètre = 10,000 mètres; a kilomètre = 1,000 mètres; a hectomètre = 100 mètres; a décamètre = 10 mètres: a décimètre = 1-10th of a mètre; a centimètre = 1-100th of a mètre; a millimètre = 1-1000th of a mètre*.

The same prefixes are similarly applied to the other units.

The mètre is the fundamental unit from which all the rest are derived, thus :—

AREA.

The unit is a *square metre*, that is, a square of which each side is a mètre in length.

VOLUME.

The unit is a *cubic metre*, that is, a cube of which each edge is a mètre in length.

CAPACITY.

The unit is the *litre*, the capacity of which is the same as the volume of a cubic décimètre.

WEIGHT.

The unit is the *gramme*, which is the weight of a cubic centimètre of distilled water, weighed in a vacuum at a temperature of 4° Centigrade.

* For very small and accurate scientific measurements, physicists use the word "micron" (1-1000th part of a millimetre).

By affixing to these units the Latin and Greek prefixes enumerated above, all the various denominations are obtained, except that the French have a second name for two of them.

The "are," which equals a square hectomètre : and the "stère," which equals a cubic mètre. The effect of these names, and of using for many purposes the word "litre" instead of "cubic décimètre," we shall see presently.

The names actually in use at the present time in France appear to be the following :—

LENGTH.—Mètre, décimètre, centimètre, millimètre, décamètre, hectomètre, kilomètre, myriamètre.

AREA.—Sq. mètre, sq. décimètre, sq. décamètre, &c.   Also the ARE (= sq. décamètre), centiare (1-100th of an are), hectare (100 ares).

VOLUME.—Cub. mètre, cub. décimètre, cub. décamètre, &c.   Also the STERE (= cub. mètre), décistère (1-10th of a stère), décastère (10 stères).

CAPACITY.—Litre, décilitre, centilitre, décalitre, hectolitre.

WEIGHT. — Gramme, décigramme, centigramme, milligramme, décagramme, hectogramme, kilogramme, quintal (100 kilogrammes), tonne, or tonneau de mer (1000 kilogrammes).

It is plain :—

That a sq. kilomètre = 100 sq. hectomètres = 10,000 sq. décamètres = 1,000,000 sq. mètres ; and similarly for the submultiples.   And that

A cub. kilomètre = 1,000 cub. hectomètres = 1,000,000 cub. décamètres = 1,000,000,000 cub. mètres ; and similarly for the sub-multiples.

In fact, the progression, instead of being by tens and tenths, proceeds in the one case by hundreds and hundredths, and, in the other, by thousands and thousandths.

Such a progression can scarcely be called a strictly decimal one. At all events it is not identical with that of the other units, which proceed by tens and tenths.

The use of the words "are," "stère," and "litre" partially overcomes this defect, because, when they are used, the progression becomes a strictly decimal one.   For example, a hectolitre = 10 décalitres =   100 litres ; a décastère = 10 stères ; a hectare = 100 ares ; a centiare = 1-100th of an are, &c.

Since a cubic centimètre of water weighs a gramme
Therefore   ,,   ,,   décimètre   ,,   ,,   ,,   a kilogramme
And   ,,   ,,   mètre   ,,   ,,   ,,   a tonne

Hence, if we know the volume of any material, we can find its weight by multiplying the volume by the specific gravity of the material in question. And conversely, if we know the weight, we can find the volume by dividing the weight by the specific gravity. Also, if we know the weight and the volume, we can find the specific gravity by dividing the weight by the volume (On these points, in connection with decimal weights and measures, see page 60).

The use of the above system, with which some of the greatest names in French history are closely interwoven, became compulsory throughout France in 1799. Its use to-day is '' obligatory in the following countries, containing a population of about 300 millions :—

Germany, Austria, Belgium, Brazil, Chili, the Argentine Republic, Spain, France, Greece, Italy, Mexico, the Netherlands, Peru, Portugal, Roumania, Servia, Sweden and Norway, Switzerland, and Venezuela.

Moreover, the same system is permissive in the following countries, which also on their side contain some 300 millions of inhabitants :—

Egypt, the United States of America, Great Britain and Ireland with a part of her Colonies, Japan, Russia, and Turkey.''*

It is impossible not to admire the disinterested and indefatigable labours of the French philosophers. Their aim was of the highest, being no less than to found a system for all time, and for the whole world. But time tries all, and to many, coldly looking backwards more than a century, the French ideals appear to have been mistaken ones.

The French thought the standard of length should be a '' natural '' one, so they proceeded with infinite labour to measure on French and Spanish soil (from Dunkirk to Barcelona) an arc of the meridian which passes through Paris. They seem to have been impelled to this course, partly through belief in the great value of a '' natural '' unit, in case of the loss, alteration, or gradual deterioration of all material copies of it ; and partly because they thought that other nations would be

    * *Le Systeme Metrique des Poids et Mesures, par. G. Bigourdan, Paris*, 1901.

more likely to adopt a unit thus derived than any one of those at that time in use in France.

These ideas do not appear to be sound.

The length thus obtained unluckily happened to bear a most awkward ratio both to the French measures and to the English yard. The result was that it took more than forty years to establish the system in France, even if now completely established (see page 95 and the Extracts in Chapter IV.), and that the English-speaking peoples have not yet adopted it.

The philosophers forgot that, after all, the standard would still partake somewhat of a national character, for was it not a meridian through Paris, and had not the measurements been made by Frenchmen on French and Spanish soil ?

They forgot (although it had previously been considered by them) that the oscillations of a simple pendulum at a particular place under particular conditions would be an equally "natural" standard, that it would be almost equally international, much more easily obtained and verified, and probably more accurate.

They forgot that the lapse of time would prove their measurement to be inaccurate—"it differs from the theoretical amount by about 1 in 4,000."*

They forgot that, if a convulsion occurred great enough to destroy the standards, it would probably be a question of "sauve qui peut," rather than of the restoration of standards.†

They forgot that, so long as the ratio was known, there was no advantage in making it any particular submultiple of a meridian ; and therefore, that they could have retained this advantage, such as it is, while choosing the length of the mètre most in harmony with the measures then in use.

They forgot that, in course of time, their standards might become empirical, as they actually have done. National standards of length are no longer legally referred to natural standards or to physical constants.

* *Encyclopædia Britannica, 9th Edition, vol. 24, p. 480.*

† *Whatever force this consideration had in 1799, it is absolutely without weight to-day, when standards are carefully preserved in more places than one in a large number of different countries.*

‘‘ Standards of length are all defined on metal bars at present in civilized countries. Various natural standards have been proposed, such as the length of the polar diameter of the earth (inch), the circumference of the earth (mètre) in a given longitude, a pendulum vibrating in one second at a fixed distance from the earth, a wave of light emitted by an incandescent gas, &c. But the difficulty of ascertaining the exact value of these lengths prevents any material standard being based upon them with the amount of accuracy that actual measurements, to be taken from the standard, require. A natural standard is therefore only a matter of sentiment.''*

Having fixed the length of the mètre, the fascination of simplicity fell upon its advocates, so all other weights and measures were derived in the simplest manner possible from that one. The practical advantages of this method of procedure are not great (see Chapter V.), and it is open to grave doubt whether the method was not ill-advised. Certain it is that, coupled with the ugly length of the mètre, it rendered the adoption of the system in France extremely difficult ; and that, at the present moment of time, the introduction of the system in its entirety by English-speaking peoples is a task of enormous difficulty.

Turning now to the advantages to this country of the introduction of the Metric System, they are three and three only :—

(1) Facility of calculation.

(2) Reduction of time spent in learning arithmetic.

(3) Uniformity with other countries.

Considering the first statement, a very large number of reckonings have to be made from day to day in businesses of nearly every kind, and it is the almost universal opinion that they would become very much shorter, if made decimally, than when made, as now, by means of the Imperial Standards. That is the real and great advantage, in this connection, of the metric system. Our present method is perfectly understood by the people at large. Neither difficulty nor confusion is experienced by any one in the ordinary transactions of buying and selling. No class of the community has any trouble in obtaining a pound of tea, a hundredweight or a ton of coals, an ounce of tobacco, a yard of cloth, a pint of beer, or anything else which is dealt with by weight or measure. The introduction of the metric system would save no appreciable time in such dealings. On the other hand, the new

* *Encyclopædia Britannica, 9th Edition, vol. 24, p. 478.*

denominations would be for a long time perplexing to many persons. While, therefore, in the reckonings of nearly every business, time would be saved, no one, outside his own business, would be a gainer ; rather would temporary inconvenience be caused to all. It is, therefore, a delusion to think that the bulk of the population would hail the change with delight. A roar of dissatisfaction is much more likely to resound through the land when the new-fangled names and dimensions have to be used. '' Fancy the bumpkin who was prepared to boast that he was within a decimeter of catching the fox as he crept through a gap about a dekameter from the white gate.''*

On the second head, the time saved in learning arithmetic at school is certainly an advantage. Nevertheless, the saving is not wholly a gain, for the study of our present more intricate methods is undoubtedly a training to the mind of some value.

The third point—uniformity with other countries—is the fundamental advantage of the metric system ; without it the game would not be worth even one-tenth of the candle. Beside this benefit, brevity of calculation and time saved in schools, dwindle into comparative insignificance ; moreover both these latter advantages can be substantially obtained by *decimalising* without *metricising* our weights and measures.

How, therefore, do we stand on this fundamental point ? Some say that about 40 per cent. of the world have not adopted the metric system ; others put it at upwards of 50 per cent, *i.e.*, at more than half of the whole. There is no need to stop to inquire whether the truth lies inside or outside those limits. One plain indisputable fact stares us in the face. Our Colonies, the United States of America, Russia, and Denmark, do *not* use the metric system. Therefore, if we adopt that system, while we put ourselves in line with the greater part of Europe, we do so at the expense of putting ourselves *out of line* with all the other English-speaking peoples of the world, and with a part of Europe. This consideration is of paramount importance. We should lose more than we gain by the change ; and, aside from its difficulties, expense, &c., we should be most ill-advised to take the plunge unless accompanied by the United States, Canada, Australia, and New Zealand. The resolution of the Colonial Premiers at the Coronation Conference—that it is advisable to adopt the Metric System of Weights and Measures for use within the Empire—is sometimes quoted. Such an abstract resolution, in which, too, the

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* *Speech of the late Mr. Beresford Hope in the House of Commons*, 1868.

United States had no part, is but a slender basis for such a conclusion. Was Canada treading in our footsteps when she adopted Decimal Coinage ? Have any of our Colonies followed us in a matter vital to the welfare of a nation—Fiscal Policy ? To rush alone headlong into such an enterprise would be rash indeed. The next chapter contains some remarks and many extracts from various sources which throw considerable light upon the real state of public opinion.

An imaginary advantage of the Metric System is that its introduction would help on the abolition of local or customary standards; it would probably act in the opposite direction.

The Imperial Standards have come into almost universal use. The Weights and Measures Act of 1878 went a long way towards securing uniformity. The Act of 1889 proceeded many steps further on the same road. One of its most salutary provisions makes it compulsory upon Inspectors to pass an official examination before being permitted to enter upon their duties. We do not even yet reap the full benefit of that provision, because inspectors previously appointed were exempted, so that there are still a considerable number, who have other duties to perform, and who lack the knowledge needed for adequately filling the positions they hold. The Acts of 1892 and 1893 were short, and need no comment here ; but in 1897 the use of metric weights and measures was legalised for all purposes. And at the present moment a Bill is before the House of Commons which has passed its second reading, and whose purport is to supply omissions in the present law and to secure greater uniformity in its administration.

Obviously the questions of what the Standards should be, and of the best way of making their use universal throughout the kingdom, are perfectly distinct. The latter is a question of framing effective laws, and of creating adequate administrative machinery for enforcing those laws. The compulsory adoption of the metric system would hinder, rather than advance, the disuse of the customary weights and measures that still prevail in some places. Those linger through the force of prejudice and habit, perhaps, too, sometimes, because they may be, after all, the best suited for the purposes to which they are put. The use of such local standards has been for many years illegal, and heavy penalties attach thereto ; the users are perfectly well acquainted with that fact, and also with the Imperial Standards ; and they have been free for some seven years to use metric standards if they please. It seems absurd to suppose that, under such circumstances, to make compulsory the use of standards that are not understood, in place of

those that are understood, would render people more likely to abandon their customary standards.   France is an example the other way. The metric system was promulgated in 1799, but an intermediate system of divisions and names had to be subsequently tolerated, and a law to that effect was passed in 1812.   Not until 1840 was the pure metrical system enforced in France, although it had been promulgated fully fledged more than 40 years before.   And even now other standards remain 64 years later.   "One might suppose that these 101 years would have sufficed to make the use of the system general in France, but this is not so.   Precious stones are to-day bought and sold in carats ; firewood in cords ; milk in pints ; gravel in toises ; grain, potatoes, and charcoal in boisseaux ; wine in barriques, feuillettes, demi-setiers, and chopines ; wood for construction in pieds, pouces, and lignes ; beer in canettes and pots ; sugar and tea among the poor people is dealt with in livres, demi-livres, &c. ; and cattle dealing is carried on in pistoles and écus, and not in francs."*   Again, Sir John Wolfe Barry recently observed : "I believe I am right in saying that to this day in Paris, the very heart of a compulsory metrical system, the opticians' work is done by the old French inch which is divided by 12, and that the dozen is still used in France in many trades." †

It is often said that the change was effected in Germany in the course of 3½ years ; but, in this connection, it should not be forgotten :

That at the time of the change decimal coinage was (and had been for several years previously) in use in Germany.

That the pound in common use in Germany was as nearly as possible half-a-kilogramme, so that *the change did not involve an alteration in the unit of weight.*

That, at the time of the change, there were in use in the various German States *a very large number of different kinds of feet.* On the other hand, "The English foot has not appreciably varied for centuries." ‡

And that old measures of length and surface are still largely used.§

* *Mr. Robert K. Gray in " The Times " (April 13, 1896). Quoted by the late Sir F. Bramwell.*

† *Meeting of the Institution of Electrical Engineers, February, 1903.*

‡ *Encyclopædia Britannica, 9th Edition, vol. 24, p. 481.*

§ *See Appendix, page 95.*

CHAPTER III.

Difficulties of the Metric System.

Unfortunately the fundamental units of the Metric System—the mètre, the litre, and the gramme—bear complex ratios to those used in this country—the yard, the gallon, and the pound.

Approximately, 1 yard = .914 of a mètre ; 1 square yard = .836 of a square mètre ; 1 cubic yard = .765 of a cubic mètre ; 1 quart = 1.136 of a litre ; 1 ℔. Avoirdupois = .454 of a kilogramme ; and 1 ℔. Troy (or Apothecaries') = .374 of a kilogramme.

It is, therefore, a simple arithmetical fact that the introduction of the Metric System would require an alteration in all our present standards. Hence the change would entail :—

FIRST, considerable dislocation of and difficulty in fixing without appreciable alteration the prices of things of small cost, which are sold singly, and of which the value is estimated by weight or measure.

For example, if half-a-pound of rice, sugar, soap, onions, &c., costs 1¾d., then, if one quarter of a kilogramme of any of them be sold for 2d., the price is raised by more than 3½ per cent ; if sold for 1¾d., it is lowered by more than 9 per cent.

If half-a-yard of flannel or calico costs 1¾d., then, if half-a-mètre be sold for 2d., the price is raised by more than 4 per cent. ; if for 1¾d., it is lowered by more than 8½ per cent.

If half-a-pint of beer or cider costs 1d., then, if ¼-litre be sold for 1d., the price is raised by more than 13½ per cent. ; if sold for ¾d., it is lowered by more than 14½ per cent.

SECONDLY, the substitution of new weights and measures for those at present in use.

THE RESULTS WOULD BE :—

(a) Heavy and widespread expense, which would fall, as was shown by the evidence given in 1895 before the Select Committee on Weights and Measures, chiefly upon the poorer classes.

Many tools and appliances, connected with civil, mechanical, and electrical engineering, would require alteration. In large works, though the cost would be great, the change might ultimately be worth, and more than worth, its cost; but, in small concerns with no foreign trade, the expense would be burdensome without sufficient countervailing advantage. This aspect, serious though it be, pales before the great trouble and outlay its introduction would impose upon all users of weights and measures. The weights of all scales would have to be changed; spring balances and lever scales re-marked; new measures for land surveyors, masons, bricklayers, carpenters, &c.; new measures for all produce sold by measure; &c., &c. In fact, every farmer, every trades-man, every householder, and nearly every workman in the land would feel the pinch. In addition, as Colonel Johnston, the Director-General of the Ordnance Survey, has pointed out, the change would alter the units of all land measures, introduce a great deal of trouble in questions of landed property, and would involve a republication of the whole of the Ordnance Survey maps and plans at a large expense. Further, Sir H. Jekyll has, at the request of the Board of Trade, sug-gested (*inter alia*) that land, which had been surveyed in accordance with the present system, should be exempt from the metric system; that the mile be retained so as to prevent the dislocation of all railway rates charged at so much per mile; a similar provision in regard to railway rates at so much a ton; and that power be taken to exempt certain trades and businesses, such as the sale of intoxicating liquor by retail and the measurement of gas, from the operation of the metric system.*

(*b*) The change of standards would create much temporary confusion, inconvenience, and facility for fraud. Here, again, the evidence before the 1895 Committee indicated that the poorer classes would be the principal sufferers. Wide and careful inquiry into this matter is needed.

(*c*) The general ignorance of the Metric System at present prevailing would cause much additional confusion. It is true that the system is taught in our elementary schools, but teachers say that very few boys or girls leave such schools with any real knowledge of it. A necessary precursor to legislation is the issue by the Board of Education of a manual containing *enough, but not more than enough,* to enable any one to use the Metric System in the ordinary business of life. The teaching of this manual should form part of the curriculum of all elementary schools, and an adequate knowledge of it be compulsory for passing the exemption standard.

* *Given in evidence before the Select Committee of the House of Lords, appointed 23rd February, 1904. (See page 58).*

(*d*) Eight different sets of weights and measures are in ordinary use—Length, Area, Solidity, Capacity, Avoirdupois, Troy, and Apothecaries' Weight, and Apothecaries' Fluid Measure. Dire, indeed, would be the toil and trouble were all these changed simultaneously. Provision should be made for their withdrawal *piecemeal*, and wide powers given to the Board of Trade in regard both to the acceleration and retardation of the introduction of each successive step.

(*e*) The compulsory adoption of the Metric System would inevitably lead to a temporary rise in the prices of weights and measures.* Just as the compulsory registration of titles to land would overwhelm conveyancing lawyers, so the compulsory adoption of metric weights and measures would throw enormous work for a time on the manufacturers of scales, weights and measures. A greatly increased demand, even when unaccompanied by a rise in the cost of labour or materials, usually brings a considerable transient rise in price. For example, during the South African War, the price of paper for newspaper printing rose at a bound by a large percentage, though it had previously been falling almost continuously for 60 or 70 years. A similar phenomenon would probably accompany the introduction of the Metric System, unless action be taken to prevent it. It is for the Government to find the best way of minimising this and other evils attendant upon its introduction ; it is beyond the power of private legislation to do so.

(*f*) Neither in this country nor in the United States is opinion by any means unanimously in favour of the Metric System.

For other difficulties in the way of the Metric System, see the preceding chapter, and also the Extracts (pp. 22-58) contained in the next chapter.

The conclusions to be drawn from the foregoing considerations are (Chapter VI., p. 70) that decimal coinage should precede decimal or metric weights and measures ; that both subjects should be dealt with, not by private members, but by the Government of the day ; and that, for dealing with them, special machinery should be created.

* *Unless bought wholesale from other countries, see page* 34.

PUBLIC OPINION.

The extracts which follow have been gathered together, not as samples of the different views held on this subject, but rather to shew that there is, on both sides of the Atlantic, a large body of what may be called " expert " opinion, which is more or less against the adoption of the metric system. That such was the case in the past, the citation of a few great names—Herschell, De Morgan, Airy, Rankine, Herbert Spencer, Napoleon—sufficiently demonstrates. In one or two instances the quotations have been taken from strong advocates of the speedy adoption in its entirety of the metric system.

As to the opinion of the bulk of the people, it may be said to be inert. The working classes in general know little and care less about it. They have heard vague talk of its introduction, and are doubtless often told of the great boon it would be to them. Once, however, let them awake, by actual experience or otherwise, to the heavy burden of trouble, confusion and expense that it would cast upon them— unless preceded by decimal coinage, and afterwards adopted in the most gradual piecemeal manner that the wit of man can devise—and a howl of execration will go through the land. I heartily concur in the statement of Sir Michael Hicks-Beach*, that such a mass of opposition would be encountered, if it were actually adopted in practice, as would necessitate the attempt being abandoned.

The metric system does not savour and ought not to savour of party warfare, and I hope it will never come within its pale. Should, however, the crude Bill now before Parliament pass into law, the party passing it, if the candidates of the other side manage to bring home to the electors its real meaning—for it does not begin to operate until 1909 !— would probably suffer at the Polls one of the most signal defeats on record.

The opinon of electrical engineers as such on this subject does not appear to be of much importance. The system is in general use among them, and its use is absolutely legal as the law now stands.† Among civil and mechanical engineers, on both sides the Atlantic, opinion

* *Speech in the House of Commons, April 16th, 1904.*

† *By an order in Council of 23rd August, 1894 (made under section 6 of the Weights and Measures Act, 1889) the fundamental electrical units—the ohm, the ampere, and the volt—are defined in terms of the metric system. They thus become, by virtue of the said Act, Board of Trade Standards just the same as if they had been included in its Second Schedule.*

is much divided. In fact, while most of those who have carefully considered the subject incline strongly to the belief that some change is desirable, there seem to be comparatively few downright thick-and-thin supporters of the compulsory adoption of the metric system without modification of any kind.

Those interested in the manufacture and those interested in the sale to the public of scales, weights, and measures are naturally disposed to take a strong view.

Likewise, a sprinkling of scientific men and schoolmasters. These last are dazzled by the arithmetical simplicity of the system and by the circumstances of its birth, but lack time, training and inclination for a careful and necessarily tedious investigation of the subject from the practical side.

Then, again, there are the faddists; but why a man becomes a faddist, or how a faddist reaches his conclusions, is difficult of explanation.

Another class of people who may be expected to take strong views are those "middlemen" whose trade lies chiefly with the continent. Persons whose business consists, not in manufacturing commodities, but in transactions whereby they are transferred from one country to another, do not feel the pinch of changes in scales, weights, measures, or modes of reckoning. They pay little attention to that aspect of the question, and naturally favour any change which promotes international trade. It may be said, and justly said, that such promotion of trade is a great good, and that middlemen so placed are the part of the community best fitted for forming a correct judgment on the point. Quite so. Let it be noted, however, that by making the change alone, WE GET OUT OF LINE WITH OUR OWN COLONIES AND WITH THE UNITED STATES, and that our trade with those countries is thereby hampered, not facilitated. Now the school of Fiscal Policy, of which those illustrious statesmen, Mr. Balfour and Mr. Chamberlain, are the great exponents, teaches that only by the expansion of our over-ocean trade can we retain our present lofty position; and that in that way we can soar to even greater heights than we have yet attained. Let not then any followers of the present Government be foolish enough to advocate the introduction of metric weights and measures, except by joint action with the countries named. I do not believe, apart from the cart-before-the-horse nature of the present Bill, that either ourselves or any of those countries are ripe for legislation on its lines. The resolution of the Colonial Premiers at the Coronation Conference, and resolutions of Chambers of Commerce, in view of the intense apathy

and ignorance of the vast bulk of the community, afford but slender grounds for believing that the change would be tolerated, much less welcomed, by the people at large in any of the countries named. The following extracts disclose the existence of a large body of adverse cultivated opinion in the United States; and I believe that, if the provisions and consequences of the present Bill were clearly and fairly set before the electors of this country and their chief local repre- sentatives—the County and Borough Councils—it would be rejected by an overwhelming majority. A similar result would follow in other countries. Suppose, however, that this view is fallacious, that we, and the other countries, are ripe for the change, then surely it is a far easier task for our statesmen to come to an international agreement than it was to conclude the recent treaty between England and France. That, indeed, was a task which might have appalled a bold man. I cannot understand any one worthy of the name of states- man, who is timid enough to shrink from making an attempt at joint action on this question with the Colonies and the United States, or foolhardy enough to embark on the enterprise alone.

EXTRACTS.

NAPOLEON'S VIEWS.

The extracts are translations by the late Sir F. Bramwell from General Comte de Montholon's book, "Napoleon at St. Helena,"

The geometers, the algebraists, were consulted in a question which was, in fact, purely one of an administrative character. They thought that the unity of weights and measures should be deduced from some natural order, so that it might be adopted by all the nations. . . .

Thus the comfort of the present generation was sacrificed to ab- straction and to vain hopes, because, for an old nation to adopt a new unit for weights and measures, it is needful to remake all rules of public administration, all the calculations used in the arts. Such a work alarms the reason. . . .

All the pieces and lines relating to architecture; all the tools and the parts used in clockwork, in jewellery, in publishing, in all the arts, in all the instruments, in all the machines, had been studied and cal- culated in the ancient nomenclature, and are expressed by simple

numbers, while the translation needed numbers composed of five or six figures ; thus all must be done over again. The '' savants '' conceived another idea, nullifying the benefits of unity of weights and measures, for they adopted in their scheme the decimal numeration ; they took the mètre as their unit, and they suppressed all other starting points. . . .

The merchants and the people found themselves harassed for that which was in fact a matter of indifference. This contributed still further to make unpopular an administration which placed itself aloof from the wants and the powers of the people ; which violently broke their practice, their habits and their customs ; just as might have been done by a Greek or Tartar conqueror, who, with the rod of power uplifted, enforced obedience to his will, who commanded according to his prejudices and his interests, regardless of those of the vanquished.

The new system of weights and measures will be the source of embarrassment and difficulty for many generations, and it is probable that the first scientific commission to whom it is given to verify the measurements of the meridian will find some corrections to make. It is a tormenting of the people for mere trifles. . . .

John Quincy Adams.

From the Report presented by him in 1821 to the House of Representatives of the United States.

The French metrologists, in the ardent and exclusive search for an universal standard from nature, seem to have viewed the subject too much with reference to the nature of things and not enough to the nature of man. Its authors do not appear to have considered the proportions dictated by nature between the physical organization of man and the *unit* of his weights and measures. The standard taken from the admeasurement of the earth has no reference to the admeasurement and power of the human body. . . .

To the common mass of the people the use of weights is in the market and the shop. The article weighed is to be carried home for the daily subsistence of the family. Subdivisions of the pound, the half, the quarter of a pound, are often necessary to conciliate the wants and the means of the neediest portion of the people, that portion to whom the justice of weight and measure is a necessary of life, and to whom it is one of the most sacred duties of the legislator to secure that justice so far as it can be secured by the operation of human institutions. The transition state in France caused frauds on the scanty pittance

of the poor. Small dealers in groceries and liquors gave the people one-fifth kilo, for ½ ℔. and one-fifth of a litre for the ½ setier. The decimal division became snares to the honesty of the seller and cheats upon the wants of the buyer.

University Convocation of the State of New York.

From the Report of the Committee of the University Convocation of the State of New York, which was appointed in 1866 at the request of the Chairman of the Committee of the House of Representatives, to inquire into the subject of a uniform system of weights and measures.

They have shared the enthusiasm which the hope of a common currency, a common unit of weight, and a common unit of measure for all nations has awakened throughout the world. They honour the French nation for having taken the first step in so great an undertaking. But in their judgment, the adoption of the metric system without modifications, and the entire obliteration of every unit of weight and measure which now form the warp of our language and the base of our traffic and commerce, while it is yet uncertain how far it would be adopted by other nations, would be most unwise. We must not forget that the introduction of the metric system carries with it the necessity of abandoning our own Saxon, and introducing a language entirely foreign which the masses will be obliged to use. . . .

If the metric system be introduced it must supersede all present systems. We must adopt the system as a whole, and exclude every other. The history of its introduction and early use in France clearly prove this. The French people struggled against it for 20 years, and finally practically overthrew it with the concurrence of the great Napoleon in the palmiest days of the Empire. Then followed 25 years of confusion, when a new revolution so strengthened the powers of the Government that the metric system was established in 1837, and the use of any other weight and measure made a penal offence. That the conflict will be fierce in this country, where the people are freer and less habituated to blind obedience to imperial edicts, cannot be doubted, nor will the fact that the system comes to us from a foreign country whose language and institutions are alike unknown to us be without its influence. . . .

They have not been able to see how any system of weights and measures can be an acceptable substitute for the one now in use unless it makes some provision for retaining the unit one foot. Can we

change the survey of an entire continent, with the description of every piece of land upon it from the unit, one acre, to the unit one are forty times less ? Can we change without great confusion the units of volume the cubic foot and the cubic yard, so familiar to every schoolboy ; and above all, can we change our unit of weight, the ℔. avoirdupois ? . . . It seems to the Committee that we must retain the following units : foot, yard, mile, quart, ℔.

Can we abandon, as a mere question of language, these short, sharp Saxon words for their equivalents expressed in a foreign language ? Besides, the foreign language which we introduce has no exact equivalent to these words which have *almost become things*, and which now form a part of the mind and knowledge of every people which speak the English tongue, or are connected with American commerce.''

The Late Mr. Beresford Hope.

From a speech in the House of Commons, 1868.

'' One-tenth part of this gram is to be a decigram, and ten times a gram is to be a dekagram, for the reformers decreed that aliquot parts were to be named after the Latin, and multiples after the Greek numerals. How in the name of common sense can we make poor people understand that because there are the letters ' ci ' in the one word it means the tenth of a gram, and that because there are the letters ' ka ' in the other, it means ten grams, or 100 decigrams ? My hon. friends the Member for Dumfries and the Member for Liverpool come to this House representing great commercial transactions ; but I stand up for the poor man. Only imagine an honest housewife going into a shop and asking for a decigram of pepper, and a dekagram of tea ; imagine, too, the milkmaid selling her fluid by the litre. The Member for Liverpool is a kind-hearted man ; is he then prepared, with all the stringent force of a penal statute, to enact that when one of his youthful constituents may desire to effect a commercial transaction in a manufacture for which one portion of that great borough is famous, he should be bound to go to the shop and tender his ' dime ' for three decigrams of Everton toffee ?

The Standards Commission.

From their Second Report, issued in 1869.

It is obvious that in this country where the people are more accustomed to self-government than in other European countries, the

executive has far less power of compelling obedience to the law in all the small transactions of trade, against the wishes of the public. Should an attempt be made at the present time to introduce the Metric system by legal compulsion, the Commission regard it as certain that very great confusion would be produced, and they think it highly probable that the attempt would be met by such an amount of resistance, active and passive, that it would totally fail. . . .

As bearing upon all parts of this inquiry, the Commission think it their duty to call attention to the advantage of establishing in this country a decimal system of coinage. The decimal division gives the greatest facilities for the gradation of prices, and for the great number of additions, multiplications, and divisions continually presenting themselves in money affairs, but more rarely occuring in the combination of the several denominations of weights and measures. And the Commission think it probable that extensive familiarity with decimal coinage would materially tend to facilitate the introduction of a decimal scale of weights and measures, where it can be useful. The Commission do not disguise their apprehension that a change of coinage would produce for a time some confusion* At the same time they observe that it is absolutely in the power of the Government to effect the change without any risk that the resistance, which might be made by those who preferred the old system, could ultimately prevail against it. . . .

Considering,—

That there is no immediate cause requiring a general change in the existing system of legal weights and measures of the country for the purposes of internal trade ;

That the statutable values of the fundamental imperial units are adopted in use without the slightest variation throughout the whole of the British Isles ;

That the primary Imperial standards are as perfect as can be made by modern skill and science, and that the whole series of official standards are now most accurately verified in relation to the primary standards :

* *Thus we see the Commissioners thought that, while any attempt to compulsorily introduce the Metric System would fail, it was within the power of Government to do so in regard to Decimal Coinage, though it would cause some confusion for a time. To this may now be added that the system of decimal coinage, explained in this book, would not cause appreciable trouble or confusion to any one.*

That a very large number of copies of the official Imperial standards, accurately verified, are now in use by the local inspectors of weights and measures ;

That it is estimated there are nearly 30 millions of ordinary weights and measures of the existing Imperial system now in common use ;

That at the present time there is no evidence to show that any considerable portion of traders and their customers in this country are dissatisfied with the Imperial system now in use, or that they desire to substitute the Metric system for it ;

We are of opinion that the general introduction of the Metric system should be permissive only, and not made compulsory by law after any period to be now specified, so far as relates to the use of Metric weights and measures for weighing and measuring goods for sale or conveyance.

Considering the great national importance of the question of the introduction of the Metric system of weights and measures into this this country,—

It appears to us essential that any measure for this object should be proposed to Parliament by the Executive Government.

The Late Sir George B. Airy.

In the statements introductory to the proposals for new systems in France, North Germany, and India, very great stress is laid on the discordance in the fundamental units of their customary weights and measures as adopted in different districts of the same empire. These reasons have no force in Great Britain and Ireland, throughout which, whatever difference may prevail as to the multiples in local use, the fundamental units, namely, the yard, the pound, the gallon, are strictly the same ; based upon national standards, which are constructed with the utmost skill and care, and supported by a system of inspection which, though chargeable with imperfections, is, on the whole, efficient. . . . .

It appears to me that the practice of mankind, as regards their selection of scales of multiples and sub-divisions, in every subject which I have examined may be described thus : For each particular subject to which measure, &c., is applied some one measure, &c., is adopted as the standard. Then the multiples of this measure, &c., are taken on the decimal scale, and the sub-divisions are taken on the binary scale. These sub-divisions are taken without any regard to their coincidence or non-coincidence with inferior measures, &c. The

coasting sailor uses the league, half league, quarter league, without regard to miles or yards. The traveller uses the mile, half mile, quarter mile, furlong ; and never combines with them the yard or the foot. The sailor in sounding uses the fathom, half fathom, quarter fathom, and thinks of no other measure. The vendor of drapery uses the yard, half yard, quarter yard, &c., down to the nail, without regard to inches. The joiner uses multiples of inches to a large number, and subdivides the inch to half, quarter, one-eighth, one-sixteenth . . . It is very little important whether the relation between the standards adopted for the different measures (for instance, the mile and the yard) be or be not simple, provided that it be ascertained.

Mr. J. C. Stevenson.

From a speech in the House of Commons, delivered July 26th, 1871. Mr. Stevenson was M.P. for South Shields from 1868 to 1895. In addition to an unusually long career in Parliament, Mr. Stevenson possesses vast commercial experience, having been for many years one of our leading chemical manufacturers, a member of the Chemical Society, and a Fellow of the Institute of Chemistry.

I think we have much reason to complain of the gross misrepresentations which have been made as to our present system of weights and measures. In a paper which has been circulated in defence of this Bill, the audacious statement is made that '' there is at present no uniformity whatever in the weights and measures at present in use.'' On the contrary, there are no countries in the world which are further advanced than Great Britain and the English speaking nations of the world in this respect. There is only one pound weight, only one inch, and one gallon all over the country. We hear of different stones weight in different markets and for different articles, but these are only different multiplies of the same well-known and accurately constructed ℔. weight. All our measurements are absolutely uniform, for there is only one foot and inch and yard. and there is now only one legal acre. . . .

I am told that in Germany they have adopted it. I believe that that is intended ; but what was their position ? A confusion of standards of weights and measures, which must be got rid of at any cost, especially to carry out the purpose of a united empire. In seventeen states of Germany the foot is of sixteen different lengths. . . . .

When the Bill was discussed in 1863 and 1864, Mr. Ewart and the advocate of the change asserted that if the system were made per-

missive, and contracts made legal in it, its great advantages would recommend themselves, and the people would demand a compulsory Bill. These expectations have been wholly falsified. There is less movement for the metric system than ever ; and the people of this country are utterly careless about it. . . .

The overturn of our present units would greatly destroy the value of all our records which involve weights and dimensions. . . .

The advocates of the metric system have constantly mixed up things which are quite separate, and taken credit for advantages by the passing of this Bill, which can only be attained by other changes in addition. They have confused together uniformity of international coinage, decimalization of our own coinage, and decimalization of weights and measures, and have claimed for the metric system advantages which might be attained independently of it. But this Bill does not touch the coinage, and yet, unless that is decimalized, the advantages of international prices cannot be realized. If these are of the importance that the advocates of this Bill assert, they should begin with decimal coinage, but that movement seems to have come to an end. There seems to be an unsurmountable difficulty in getting quit of the sovereign at one end of the scale and of the penny at the other end.* And not until this difficulty be surmounted will it be time to talk of the smaller difficulties to foreign trade interposed by the diverse standards of weights and measures.

I maintain that these difficulties have been enormously exaggerated and, moreover, that the persons on whom they fall are those who can most easily overcome them—to whom they are least a difficulty. The merchants who carry on our trade with the metric countries are perfectly well able to make the necessary reductions of the sizes and weights of the one system into those of the other. . . .

Foreign trade is in wholesale transactions ; goods are imported in large quantities or cargoes, and the simple arithmetical operation necessary for converting the weight is done only once for the large quantity—and yet to save trouble to the merchant's clerk who makes this calculation, all the shopkeepers who sell the article in the minutest detail, and their customers who buy the smallest quantities, are to be perplexed and worried by the compulsory introduction of utterly un-known and unintelligible ideas into the concerns of their daily life. . . .

* *This imaginary difficulty was created by the report of the Royal Commission in* 1859. *See chapter on Decimal Coinage (pp* 1-8).

Suppose you passed this Bill and it had come into operation, and you had dragooned the people into submission to it, and succeeded in sweeping every pound and ounce weight and every yard measure from all the counters and market stalls in the kingdom, have you even then abolished feet and inches and lbs. weight ? So far the law would be satisfied ; but you would be still far short of your purpose, for there would remain an indefinitely long period of transition and confusion. There are countless manufacturers that turn out articles in definite sizes and definite weights, and those weights and sizes are part of the name of the article.   .   .   .

I have beside me a large collection of price lists, and it is appalling to see what confusion would be introduced into all dealings with the articles named by their becoming unrecognisable under the new names of the metric systems.   .   .   .

A hardware merchant's price list would furnish me with endless instances of the way in which the present units of size enter into the names and classification of articles of trade.   .   .   .

I have in my hand the price list of a dealer in soft goods, and there too I find that in numerous instances feet and inches are used as part of the essence of the names.   .   .   .   .

I should only weary the House were I to enumerate many more cases in which it would be extremely costly and inconvenient, if even possible, to alter the sizes of articles based upon the present units.   .   .

This question must be discussed in its bearings, not on this country only, but on the United States and all our colonies who have, with our language, adopted our units of measure and weight.   .   .   .

Mr. J. C. Stevenson.
Written November, 1871.

In the North of Italy, the mètre is adopted, and yet I bought once a stock of workmen's rules at Chatillon, of the length of 24 old inches, and jointed to suit these inches, and graduated on one side in inches and on the other side in centimètres, the 24 inches being rather more than a mètre. I found a similar rule in use by workmen on the shores of Lago Maggiore.

As showing the need of a unit like the ounce for small trading purposes, I saw on an open-air stall in Venice a card on a piece of cheese quoting the price as so many centesimi for 48 grammes, or about 1¾ ounces.

At Mulhausen, which, though recently detached from France,

has been subjected to the same long course of metric legislation, I found that the metric rules in stock in a large hardware shop were graduated on one side into 100 centimètres and on the other into 36 '' pouces,'' showing that the '' système usuel,'' permitted in 1812, still retains its hold, although now illegal, and the necessity felt for having such a unit as the inch. In the same shop I saw some tools for cutting to various thicknesses, and the scale on which the cutting edge moved was graduated in these inches. I found also that the various lengths of nails were described as inch, inch and a half, &c. Thus the language of the law after nearly a century of legislation has not eradicated the old language of the workshop in the parent country of the metrical system.

FROM THE REPORT OF THE 1895 SELECT COMMITTEE ON WEIGHTS AND MEASURES.

Amendment moved by Mr. Stevenson who was a Member of the Committee. The Amendment was not adopted.

'' No witnesses were called to represent numerous classes of the community, wholesale and retail traders, and their customers, whose transactions in daily life would be disturbed by the compulsory abolition of the long familiar standards, and who had expressed no desire for a change.''

From Evidence of Mr. J. Emerson Dowson.

MR. STEVENSON : With regard to Germany, allow me to call your attention to some of the evidence given in 1862. Dr. Karl Kurmarsch was asked, at Question 2946, '' Is the present system of measurement by feet a source of much confusion ? '' and he replied, '' Yes, in Germany there are many different feet. We have about 30 different feet. Every State of Germany has a particular foot.'' Was it ever the case in this country that there were different feet ?—I should think not.

From Evidence of Mr. A. Siemens

MR. CROMBIE : Did not you say that the Customs pound was an even multiple of the kilogramme ?—It is half a kilogramme.
Therefore the transition, so far as units go, would be easier in Germany than in England, would it not ?—As far as a unit weight was concerned, it was certainly easier, and it was made still easier by

their not adopting the kilogramme, but the pound, as the unit ; but afterwards, in 1877, they were compelled to change that, and make the kilogramme the unit.

From Evidence of Mr. Cheney.

Sir Henry Roscoe : What have you to say as to who are the great users of weights and measures ; is it the manufacturer who sells and the merchant who buys by a written order, or the shopkeeper who sells over the counter ?—I regret I can offer the Committee very little evidence on that point. It involves questions as to what is the proportion of retail traders to wholesale traders. Our information goes to show that the more important user is the retail seller and the retail buyer, that the use by others is nothing so large as that of the retail buyer and seller. . . . .

Sir Henry Roscoe : So that not only the standard of length and the standard of weight, but also the standard of capacity, becomes, in the metrical system, an arbitrary unit ?—Yes, the unit of capacity may appear to some to be less arbitrary, because it has a physical definition, as the weight of a given volume of water contained in a certain vessel.

Sir Henry Roscoe : Have you read or heard whether there was any great difficulty found in France at the time of the change from the old system to the new metrical system ?—I conclude that there was very great difficulty. . . .

Mb. Webster : Was there any difficulty arising from the change ? —There appears to have been great difficulty in passing from the Scotch weights and measures to the English, as may be seen from the report of Lord Ebrington's Committee in 1834.

From Evidence of Mr. Alfred Spencer.

Sir Edward Hill : You are aware that other nations had similarly complicated, if not worse systems of measures than ours, and have succeeded in introducing the metric system without any serious inconvenience, are you not ?—Those are cases where there were very complicated and difficult systems, as for instance in Austria and Germany, where the whole public were suffering from the constant inconvenience, and there was a public demand for a new system, which paved the way for a new system. If there had been the same amount of inconvenience and a similar demand here amongst the people generally, I should see no difficulty ; but it is because there is no such inconvenience and no such demand that I see difficulty. . . .

Mr. Stevenson : In those countries where you claim the advantage of the decimal system, it is when both the money and the weights and measures are on the same decimal system, is it not ?—Doubtless that is so.

From Evidence of Mr. Wollmer.

Sir Henry Roscoe : Then, do I understand that in the yarn trade the metric system is not in use by the other countries ?—Practically, only by France. Some other countries buy yarns in kilos, but the "make-up" of the yarn is according to the English system.

Mr. Stevenson : Do you mean the standard of fineness ?—Yes ; to arrive at the count of the yarn, it is only in France they do it according to the metric system ; they make so many thousand mètres to the half kilo, whilst all other countries have the English system of 840 yards to the hank and so many hanks to the pound.

From Evidence of Professor Prytz, in regard to Denmark.

Mr. Jasper Moore : Then there is not a unanimous opinion ; everybody is not of the same opinion ?—No.

Do you know what the lower classes think on the same subject ?— I think they are against the metric system ; but the higher class are in favour of it.

From Evidence of Mr. Umney.

Sir Henry Roscoe : What is the opinion of the chemical section of the London Chamber of Commerce in connection with this matter ?— They agree that it is most desirable that the metric system should be permitted. Its compulsory introduction would, of course, upset trading, and would, it is thought, be a very great mistake.

From Evidence of Sir Robert Giffen.

Sir Edward Hill : Of course, you are aware that other countries which formerly had complicated and difficult systems of weights and measures changed those systems for the metrical one, and have now adopted the metrical system ?—I think, also, we must recognise that in many cases the change from a very bad system to another system than the metrical system would have been an improvement.

Do you anticipate that there will be any more difficulty in England in making that change than there has been found to be in those countries ? —I do not think I am prepared to go into that point. That would

involve many considerations ; considerations of expediency and policy, and questions of that kind which I am not prepared to discuss.

So far as the metrical system is concerned, it is a system which meets with your approval ?—I think it is one good system as far as it goes.

And assuming it were desirable to change our system, would you be of opinion that it would be most advantageous to adopt such a system as is most in accordance with the rest of the civilised world ?—No doubt, as far as we can. .   .   .

Mr. STEVENSON : For shipping purposes, is not the English ton register of shipping universal all over the world ?—It is very general ; and I believe there is a common system of tonnage which is gradually getting into use throughout the world.

Is the system of measurement enacted by law in each country so arranged as to bring out the tonnage of a ship exactly the same as if it had been an English ship measured at an English port ?—I believe that is the intention ; how far it is carried out may be a different question.

From Evidence of Sir Benjamin Baker, F.R.S.

Mr. STEVENSON : In the case of the steel sleeper where you wished to ascertain the amount of the waste, the trouble arose by the use of the cwt. and qrs. If you had stated the original weight and the ultimate weight simply in lbs. there would have been no difficulty, would there ? —No difficulty at all. It would convey the same impression ; you would see at a glance that the loss was so much.

There is no question of system involved in it, so long as you stick to one unit is there ?—No, that was one of the practical inconveniences involving loss of time which are incident to our system of cwts., qrs., and lbs.

If we followed the example of the Americans, and dropped the cwts., qrs,, and stones, and talked only of lbs., you would avoid that difficulty ?—Yes.

That is to say, without altering our system of measurements ?— Yes, quite so.

From Evidence of Mr. C. F. Howard.

SIR HENRY ROSCOE : You have written a book upon the subject, which you have presented to the Committee ?—For 25 years I have made this subject a special study, and it is only in the last 10 years that I have realised the superiority of the British system. .   .   .

Then, as I understand, your opinion is averse to the adoption in England of the metric system ?—It would not only be a national, but a world-wide calamity.

Then do you consider that it is a world-wide calamity that that system has been adopted by the greater portion of the civilised world already ?—But it has not been adopted by any country in the world that had ever had the advantage of the British system ; and, apart from that, from my researches I find that in the most ancient periods of history, right down to the present time, the inch, the foot, and the £ belonging to the British system formed part of all those systems of money and weights and measures which I have been able to trace on the face of the earth ; and the division of the standard units is by 12's and by 20's. Very recently in Troy, in excavations in old Troy, a gold coin was found weighing 240 grains which bears that out. . . .

But no other nation ever did have the advantage of the British system ?—The Americans have it.

They were part and parcel of ourselves, and they carried it over with them ; but no other nation that had the opportunity has ever adopted it. I put to a witness some time ago whether he thought that the Germans, the Spaniards, or the Italians would ever have adopted our system, and he ridiculed the idea ?—The Germans, as I suppose you are aware, had at least 25 different yard measures, and about 27 different pound weights, and their system was in the most hopeless confusion, so that it was a very good thing for them that they should accept the French system and adopt it, because it did away with their inter-state controversies as to which should be the Imperial system.

From Evidence of Mr. Stevenson, who was a member of the Committee,

Since I have given attention to this matter, beginning with a very strong inclination in favour of our decimal system, I have been and am still anxious that facilities should be given for decimal calculations and decimal measurements, on account of the advantages they possess in many respects ; but I feel strongly against any disturbance of our existing units. . . . It appears to me that it is a question of the English language. These units of weights and measures are part of our language, with which we express in words our mental conception of size and distance, and to render them illegal in trade would cause very great confusion in actual life. . . . I have here the last Army Return, and on page 65 of it we are given the heights of non-commissioned officers and men of the army and militia and their chest measurements ; they are tabulated according to the different branches of the service,

in columns of men under 5 feet 5 and men of 6 feet and upwards. They are all put in feet and inches. If we were compelled to adopt the metric system for trade, are we still to keep it for statistical information ? I find that under the column from 5 feet 5 inches to 5 feet 6 inches, figures which are quite familiar to us, we should have to face the figures 1.524 mètres ; and in the last column but one the tall men, who are called here 5 feet 11 inches to 6 feet, should go in a similar return (and probably would in France) as 1.829 metres. . . . The loss of labour by rendering unintelligible all the maps of the Ordnance Survey, which has been going on in this country for a hundred years, all of which are scaled to miles, of so many feet or inches to a mile, seems to me to be overwhelming. If we are to change all those maps, and if we are to use nothing but mètres in trade, I do not see how we can keep on using anything but mètres in agricultural statistics and in land measurements. Then, I had given to me the other day an annual volume of agricultural statistics which sets forth the prices of grain of every kind for so many years past, oats and barley and wheat ; it sets forth also the produce per acre in different seasons of those different kinds of grain, carrying them back for a great many years. If in future statistics those are to be rendered in the language of the metric system, I see that a great break of continuity from the present system, and considerable confusion would necessarily arise ; and although witnesses before this Committee have stated pretty freely that it would only take three or four years for the transition period, you cannot change the language and thoughts of the country in, perhaps, as many generations ; and agriculturists would still continue to talk of a crop of turnips as so many tons to the acre, and would not be able to forget it, or to express an idea which is clear to their minds in the language of the metric system. . . .

But, as regards all these difficulties, has not Germany passed through them all, and yet survived ?—I cannot deny that ; but I do not see why, when there is no necessity for it, we should be subjected to what must have been the inconvenience that Germany had to pass through. We have evidence before us that in Germany there was a different foot-rule for every State in Germany.

Have you heard any expression of regret from Germans of position that they have gone through those difficulties ?—The voiceless multitude who suffer inconvenience are not heard in those matters. . . .

Now, with regard to English-speaking countries, we were told that a proposal has been made some years ago to use the kilogramme as the standard of weight throughout India. I was not surprised (I knew it at the time), when that proposal was made, that many London mer-

chants, when they heard that it was practically proposed to make India a foreign country with regard to the language of weights and measures, protested against it, and the proposal was withdrawn.

We did not hear that; that was not the statement?—No, I am telling you that. I knew it of my own knowledge at the time. And I may also say that since then, in 1889, when Lord Cross was Secretary of State for India, the English yard, foot, and inch were adopted as the standard measures of length for India, and copies were provided in different parts of the country for the purpose. . . .

I could multiply instances of the confusion which the adoption of the metric system would cause in the way of catalogues. I have here a catalogue of Mr. Cameron, the well-known manufacturer of pumps; a price list with pumps varying by half-inches from two inches diameter to six inches diameter, and he has in Imperial weights and measures the quantity pumped per hour, the diameter in inches of the steam cylinders, and steam pipes and exhaust pipes, the diameter of suction pipes, the height and width occupied by the pump as it stands, the weight in cwts., followed by the price of the pump, and the duty which it would do in the way of gallons per minute. What Mr. Cameron would have to do in publishing his catalogue, if the metric system should be made compulsory, I am at a loss to know. . . .

I will only allude to statistics and railway rates, which there was such a great fight over before two Houses of Parliament a year or two ago, as to the maximum rates. These were all rendered in pence per ton per mile; and, if the tons were but slightly altered in the metric system, certainly the mileage would have to be altered, and replaced by the kilomètres. I do not think $1\frac{1}{4}$d. per ton per mile, or whatever it be, would fit very well with the metric system. . . .

I hold in my hand also a price list of one of the largest warehousemen in London, containing 480 pages, with every description of drapery goods and hosiery, which contains thousands of dimensions of feet and inches, and my comment upon that is that I do not see how the change is to be made, how all these dimensions are to be translated and written into the metric system.

Dr. Hurter,

Head of the Central Laboratory of the United Alkali Company.

" In many of our works' laboratories the metric system is in use for analytical purposes; it is, however, a great mistake to think that

the metric system confers any benefit even in this application. I am perfectly acquainted with both systems. I have, much against my own wishes, returned to the metric system in the central laboratory, which is supposed to be engaged chiefly in research work. I am, therefore, at present again in the metric system, and have been for the last five years, and I have no hesitation whatever in saying that there is no benefit whatever in the metric units of weight and measure ; for analytical purposes the grain is in every way a superior unit. The only benefit arising from the use of the metric system is that it is a decimal system, but that is in no way a property inherent in the units of the system ; my grain system was just as much a decimal system. It is necessary to keep apart the two things, the decimal system and the metric units of weight and measure. In many operations the decimal system is of enormous advantage, but it is not universally so.

Mr. C. T. Porter,

A former President of the American Society of Mechanical Engineers. Appeared in " Engineering News," December, 1902.

" ABSURD ! " Yes, that is the word with which the Committee of the American Society of Mechanical Engineers on the metric system fitly characterised and contemptuously dismissed the Bill, now before Congress, making our system of linear measurement illegal. That word was the necessary conclusion from the facts presented in the report of the Committee.

" The promoters of this measure were very properly excused on the ground of ignorance. If they had the least idea of what they were doing, of the unapproachable excellence of the system of linear measurement on which they were laying their hands—an excellence which is briefly outlined in the report of the Committee, but which can be realised only by those who are familiar with its use—their advocacy of this Bill would be without excuse, or rather it would be an act of which they would be incapable.

" To begin with, I arraign the metric system itself as absurd. The idea on which this system was founded was big and childish ; one which no people except the French could ever have thought of. To them it seemed sublime. They would take for a unit 1-10 millionth quadrant of the meridian, or the distance on the earth's surface from the Equator to the Pole, and make this unit of a grand decimal system of measurement of everything on the earth and in the heavens ; and from this they would derive a unit for another grand universal decimal system

of weight. After the mètre had been materialised in a metal bar, and this bar had been legally proclaimed to the world as the said universal unit, it was found to be too short, and the absurdity of this visionary fantasy stood exposed. The mètre is merely an arbitrary unit, as any unit of measure or weight must necessarily be.

'' This performance would be too ridiculous to notice were it not for these two facts. The metric system is still proclaimed to be the grand universal scientific system of weight and measure, and many merely theoretical minds, and I am sorry to say some practical mechanical minds also in this country, are dazzled by its brilliant pretensions. The fantastic foundation is also a key to the character of the system. We shall see that as a whole it is the product of the same merely theoretical and visionary minds.

'' Secondly, the metric system is absurd in confounding together weights and measures, things which are entirely dissimilar and unrelated, and applying the same system of division to both. Universality was the hobby and the blunder of its schemers. Thus we have this result. Physicists deal with minute quantities, and do not measure, but only weigh. In the free exercise of their right to choice, they found the gram and its decimal divisions to be admirably adapted to their use ; their work lying within the natural field of the decimal system. From this they jumped to the universal conclusion, which is not merely unscientific, but is senseless, that the metric system must be equally suited to everything : to things, large as well as small, and to measurements as well as to weight. But English-speaking people who measure do not agree with them. Therefore these people must be deprived of their right of choice, and compelled by law to take the medicine that these doctors think will be good for them. This illustrates a radical absurdity of the metric system, applying one universal method to everything.

'' Confining our attention now to measurement, with which mechanical engineers are chiefly concerned, I note, thirdly, that the metric system is absurd in ordaining a single unit of measurement for everything, from the least to the greatest, when all other systems employ a number of units, each one especially adapted to a larger or a smaller field. This absurdity stands confessed. The metricians found themselves after all compelled to employ three units, the additional ones being the kilomètre for land measures, and the millimètre for mechanical measures, thus making necessary the use of three decimal points.

'' Fourthly, the metric system is absurd in forbidding the use of division by continual bisection, the natural method which first occurs

to everybody, and which possesses important advantages, as mentioned in the report of the Committee ; thus interfering with individual freedom of choice, which is a natural right, and ordaining for universal use the decimal system of division only, the proper field of which is in the expression of very small or fractional quantities, and which is wholly unsuited to express large dimensions.

" This absurdity is realised in its utmost aggravated form in mechanical measurements, in which every dimension, however large, it was found necessary in the metric system to express in millimètres, the smallest unit, .03937079 inch. Thus, 38 feet are 11,558 mm., and these five figures and two letters must be written. Nice to remember ! We might just as well be compelled to express all divisions of the circle or of time in seconds.

" But, say the metricians, we want uniformity. Well, in the English system of linear measurement we have uniformity. It presents the very ideal of uniformity. Throughout the United States and the British Empire, all English-speaking people on the globe, in their great variety of occupations, every man who measures any thing for any purpose, all employ the same identical system of measurement. Its great practical excellence has compelled its universal adoption by men free to use the metric or any other system if they want to, and with the same freedom of choice this excellence will make its use universal.

" The proposed law excepts land measurement. The same reason would cause all measurement to be excepted from it. Yea, they are tenfold stronger in the case of mechanical measurement. It would produce quite as great confusion or chaos in mechanical as in land measurements—indeed far greater. Its disastrous effects in cutting us off from our mechanical past, and in annihilating our standards and our literature, would be inconceivable, and all for what ? Echo answers, What ?

" A judicious law, giving to this nation the same uniformity of weights that we now enjoy of measures of length, would doubtless be hailed as a benefit. Adherence to the proposed law, applying the metric system, which confounds measures and weights, and applies one arbitrary system to both, will bring our legislators, sooner or later, to realise that our system of linear measurement is interwoven with the life of this people ; that they realise its inestimable value, and that they are fully able to maintain it.

MEETING OF THE INSTITUTION OF ELECTRICAL ENGINEERS, FEB., 1903.

The late Sir F. Bramwell, F.R.S.

The advocates of the metric system can now, after this Act of 1897, do what they like—have their weights, keep their accounts, do everything that they please. "No," they said, "that will not do for us. You shall use the metric system, whether you like it or not." That is not the survival of the fittest, and it is inconsistent with anything like liberty. The only thing of which it reminds one is the now somewhat old tale of the man who said "Sir, this is the freest country on earth; every man does as he likes, and if he does not we make him." . .

Now may I refer to Mr. Coleman Sellers. I need hardly tell you that he is the Whitworth of the United States ? He tried the metric system for twenty years in one department of his works, and condemned it. Rankine, again, is not a bad name to quote. His feeling in opposition to the metric system was so great that he broke into poetry, the celebrated "Song of the three-foot rule," the concluding lines of which are—

>"Oh, bless their eyes, if ever they tries
>To put down the three-foot rule."

I cannot help thinking that the second word of the first line must be a typographical error ! . . .

I wish to thank Mr. Siemens for having endeavoured to call my attention to a mistake into which I had fallen. His observations were perfectly pertinent to the occasion. I imagined that those tremendous penalties in the Acts were penalties invented by the advocates of the metric system to get it enforced. He tried to call my attention to the fact they were a mere repetition of the penalties existing in the Acts which enforce the English system. All I can say about it is, that although they sound equally dreadful in both cases, to my mind under the English system there was so little likelihood of punishment that the penalties, dreadful as they were, were not likely to be inflicted : whereas, if the same penalties are enforced in regard to the compulsory introduction of the metric system, infringement and punishment will, I expect, be very great.

Mr. Leslie S. Robertson.

We all admit the advantages of the metric system, and they are many, but it is no good merely discussing the question from a general point of view. The metric system is permissible in this country ; anybody can use it who wants to. The question is whether this meeting

thinks it justifiable to urge upon the Government, which is the only body that can take any action in the matter, that they should make the metric system compulsory. That is a very drastic step to take. Perhaps there will be some definite resolution before the meeting prior to its close, but I venture to think that the meeting will have to consider very carefully before they come to a vote on the question as to whether they are in favour of making the metric system compulsory in this country. It is now legal, as I said before, and anybody can use it who wishes to do so, but it is a very open question whether public opinion is sufficiently ripe for the metric system to be compulsorily forced on the country by the Government.

Sir John Wolfe Barry, F.R.S.

I am bold enough, however, to say that I am averse to the mètre as a unit, and that I am averse to the decimal system for many purposes of calculation. I do not mean to say that both may not be useful to many people, but I am perfectly certain that they are by no means desirable for everybody. . . . Our object ought to be to get the best system, and to see that we are satisfied that it is the best system. If it be the best system, I hold that Great Britain, with her Colonies and Dependencies and the United States, will set the tune, and that other nations will follow. Therefore, let us see what is the best, and not rush at the metrical or decimal system, because we are told that a number of people who, with the exception of their latest proselyte, Germany, are not great commercial peoples, have adopted the metrical system.

I have worked in times past a good deal with my hands, and I am certain that the mètre is too large a unit ; it is not convenient. The foot is infinitely more convenient for all work in which I was engaged. Again, I hold most strongly that the possibilities of division of 12 are far more convenient for practical men than any system based on 10. . .

We talk about international trade. What is our position in regard to international trade, and how much do we export into all these protected countries who have adopted the metrical system ? Why do we want to make it easy for continental nations to supply our home and colonial markets when we get no reciprocity whatever ? I am not saying that that is a reason in itself against the decimal system or the metrical system, or in favour of the duodecimal system, but I merely allude to it because those who so ardently advocate the metrical and the decimal system say that it is necessary for our international trade. I do not think it is necessary for international trade in the sense in which

that is understood. Some previous speaker said with great truth that it will make it uncommonly easy for our friends who are represented by Mr. Siemens here, or who are at any rate represented by his family, to compete with us in every market in the world. I have no doubt it may do so, but is that a reason for our getting rid of convenient units and adopting inconvenient units ? . . .

What is to be done with all the measurements of latitude and longitude ? Are they to be all made decimal, and are our sailors to be forbidden to sound in fathoms ? . . .

I do not speak from want of experience in practical work, as I worked at the bench myself for a year and a half, and I have spent a great deal of time in the computation of measurements.

Sir William Preece, F.R.S.

On this particular subject the line that I take up is this. It is no new fad of mine, for I find that in March, 1853, exactly fifty years ago, I wrote a paper on the advantages of the decimal and the metrical system, and my fifty years' experience has been an addition to the strength of the feeling I had then and have now, that there is a great deal in the metrical system, but a great deal more in the decimal system. The two are totally different : you must deal with each on its own merits. First of all, I say that if the metric system or the decimal system is to be introduced, it must be because there is a necessity for it. Either there is a necessity for it or there is not. If there is not, no compulsory Act of Parliament, no resolution of this Institution will force on this country a thing that is not wanted. If it is wanted it does not require an Act of Parliament to enforce it. Necessity, commerce, the demands of trade, the business of this country, will introduce a system, decimal or metrical, into the habits and customs of our workshops.

Mr. Bennett H. Brough.

Watt's ingenious idea of dividing the pound decimally was anticipated in 1620, by Edmund Gunter, who proposed a decimal measure for land, the unit being the chain of 100 links. This convenient measure by which 10 square chains were made equal to an acre, is still in general use, and the conditions of land tenure are such as to render its displacement unlikely. The engineer for levelling uses the foot decimally divided. It is evident, therefore, that he is not averse, when necessary, to using decimal measures. The matter is entirely different if he is to be publicly punished by fine or imprisonment, if he uses anything else.

The whole question is one of commercial expediency. It is quite possible that to the electrical engineer the compulsory change, which would undoubtedly be of inestimable advantage to Germany, would not be so disastrous as to the mechanical engineer, for the electrical engineer derives great benefit from German skill. Customs returns show that of electrical machinery the British imports from Germany are twenty times as great as the British exports to that empire. In other branches of engineering the change would be all to the advantage of Germany. The cost of compulsory change would be enormous. Every retail trader would require a new set of weights and measures (which German makers would have in stock to supply). Every gas pipe would have to be torn out of our houses. The Whitworth thread would have to go, all gauges and templates scrapped, and the working man fined or imprisoned if he drank his beer out of a pint-pot. Even in Germany the change had been made with difficulty ; and Rhenish inches, Lachters, Thalers, and Groschen are still found in use. In discussions of this kind the metric advocates are apt to be led astray by their enthusiasm for a fantastic natural unit, which, after all, as the meridian was inaccurately measured, is only an arbitrary one.

Mr. Tannett Walker.

I have come over two hundred miles for the purpose of speaking. because I am a very strong believer and thinker on the subject. . . , With regard to the dimensions, the weights and measures, I absolutely agree with Sir John Wolfe Barry in what he said ; in fact, I would go further. I personally, in the course of my business as an engineer, have a good deal to do with calculations, and I have the greatest horror of this decimal system. I will tell you a story which will point to what I mean, rightly or wrongly. A Chancellor of the Exchequer received a deputation on the subject of the decimal system. The deputation was composed chiefly of commercial men, who, although they knew very little whether they meant the decimal system or the metrical system, honestly believed in what they had to say. They proceeded to describe the advantages of the decimal system. He said, '' Gentlemen, do not waste your time ; I have devoted immense thought to this subject and am a convinced believer in the decimal system.'' But these gentlemen felt themselves obliged to say something, and they urged that they could put before him certain points which would strengthen his advocacy of their cause. '' Oh, well,'' said the noble lord, '' by all means put your views before me, but, remember, I am a convinced believer, after great thought, in the decimal system.'' The Chairman then explained fully in what way everything would be worked

out with the decimal system. "Most interesting," said the Chancellor of the Exchequer, "but tell me what are those beastly little black dots?"

Colonel Crompton, C.B.

A good deal of irrelevant matter has been brought into this discussion. Surely the first question for us to consider is whether a change to the metric system is possible, even if it is desirable. Although we all desire uniformity and simplification in our calculation of money, weights, and measures, we must remember that changing any linear standard affects the mechanical engineers of the world far more than any one else, and of these engineers America, England, and her Colonies constitute the majority. How then will the arguments that have been here used in favour of the metric system be received in America? Although Mr. Shoolbred has said that in America there are signs of a change of opinion in favour of the metric system, I must emphatically contradict him. The state of American opinion is well shown from the recent discussions on this subject of papers read before the American Society of Mechanical Engineers. The discussion on Mr. Halsey's paper on the metric system lasted two days, and was followed by numerous letters from manufacturers, all showing that no one in America favoured the metric system. . . . . . .

In Mr. Halsey's paper the following words occur :—

"The chief value of a standard lies in the fact that it is adopted, that it has become a part of our daily lives, and works so smoothly that we are scarcely aware of its existence. For example, the value of pipe thread standards is not represented by the tap and dies in the hands of pipe makers and fitters, but by the fact that because the threads are standardised, pipe fittings can be made by the million at trifling cost. The cost of changing our pipe thread standard is not represented by the cost of new taps and dies, but by the confusion involved in getting from one standard to another, a confusion which will last until all existing steam, water, and gas pipes have disappeared, and it will not be lessened by putting off the change until it is brought about at the suggestion and convenience of manufacturers. It is because of our standards and our standardised methods that American mechanical industries are great. It is in this that we lead and by this sign we conquer. It is this that distinguishes us from the remainder of the world, and having the lead which such things give us, we are asked to abandon it and line up in the race afresh, and this in the name of progress."

He further went on to say that no mechanical engineering society had said a word in favour of the metric system.

If this is the state of things in America, and I believe that it is so, we in this room must see the enormous importance and immense sum of money involved in a compulsory change of linear measure when applied to the two great mechanical nations of the world.

For the reasons above given, the possibility of simplifying money, weights, and measures of capacity by decimalising them is quite of a different order of possibility to that of changing linear standards. Sellars points out that the capital expended in measuring plant, which is not likely to be scrapped or made obsolete in any way except by this change is, in the English-speaking and inch-using countries, America, England and her Colonies, many times greater than the capital already expended in the countries using the metric system. Of course this applies equally to Professor Stoney's proposal to alter the inch. If any change is possible in the future, it will be that of altering the millimetre to become the exact 25th of the inch. The tail cannot wag the dog, and in this particular instance the tail is the metric system and the dog is the inch.

Another point where the inch divided on the binary scale is superior to any system based wholly on decimal division is that of screw threads. It is found in practice awkward and inconvenient to use decimally divided leading screws for lathes, so that even in countries using metric systems most of the screws used have threads of Whitworth pitches based on the binary scale, and whenever metric leading screws are used these also are to some extent on the binary scale, that is to say, they use 4-millimètre, 6-millimètre, and 8-millimètre pitch and so on ; but even then they are more inconvenient than Whitworth leading screws based on the inch divided on the binary scale. Of course this defect has nothing to do with the metric system, but shows the inferiority for this purpose of the decimal to the duodecimal system of division. The result of this is that in countries using the mètre we find two sets of measurements on one drawing, the metric for most of the details, but Whitworth pitches and dimensions specified for the screws. The Whitworth scale of pitches at so many threads to the inch is simple and easily remembered, but on the metric system, in order to avoid confusion and mistakes, the names of the pitches must be given in tenths of millimètres, so that we find the change wheel tables for their lathes naming the pitches in tenths of millimètres, such as seventy-seven tenths, and so on.

MEETING OF THE ROYAL STATISTICAL SOCIETY, DECEMBER 31ST, 1903.

Mr. George Moores

explained that he was a great believer in the metric system, but he would like to see a metric system based on a different unit to the mètre. He thought that the Decimal Association was working on the wrong lines when they sought to get the system in use in France adopted in this country. In his opinion they missed the great essential. The base measurement was not necessarily a mètre. If it had not been for such an outlandish length as the mètre being adopted when the metrical system was introduced, the metric system must have become universal long ago. He believed the best unit for a metric system was the English inch. He would give them the opinions of some witnesses who had been examined, in 1902, by the Committee referred to by Lord Belhaven, who would perhaps be interested in hearing some expressions of opinion of very well known people in the United States. For example, Mr. J. H. Linnard, a naval constructor to the United States Government, who said he was familiar with the use of both systems, testified that he did not consider the metric system suitable for the United States. This gentleman further observed that when he was in France he was familiar with the ordinary operations of the family there. Nobody ever bought a kilogram of meat ; they bought a half-kilogram, and they called it a livre—a pound. Again, Mr. G. A. Bond, representing the Pratt and Witney Company, a great firm of American engineers, said that although his firm built standard measuring machines and gauges, they had found for a good many years, and still found, that the English system of linear measure was more convenient than the metric for their use. The representative of another firm of manufacturers, said that such legislation as was proposed could never effect the substitution of a new for an old system, and he believed the system of furnishing standard sizes to insure the interchangeability of parts, and to allow of convenience in ordering, had so far permeated all branches of mechanical production, that passing laws such as proposed would only make any new conditions imposed by Congress far worse than the present. In the end the Bill was dropped, and another attempt to get the Bill adopted this year met with the same fate.

. . . .

Mr. Robert Gray

speaking as one connected with scientific matters, said he could not say anything against either the metric or the decimal system in this direction because he found them very useful. But from the

general point of view he rather felt inclined to follow the late Mr. Herbert Spencer and the late Sir Frederick Bramwell in their objections to the compulsory employment of these systems. The principal objection he had to metric decimalisation was the inconvenience of the units arrived at. No doubt those units could be more or less adapted to the weights and measures generally in use, but they would not be absolutely convenient, and there was considerable difficulty in so adapting them. As the system stood, they had as a maximum weight a kilogramme of only 2.207 pounds, and that was far too small for ordinary use. The metric tonne, he believed, was a subsequent addition to the system, as it has neither a Latin or Greek prefix, nor any nominal relationship to the gramme. Taking the smaller measurements, they had the gramme, but the gramme was not small enough for certain things. Of course there was the milligramme, which was absurdly small, about one sixty-sixth of a grain. If the gramme had been one hundred times its present weight it would have proved a more serviceable unit. All through the measures and weights they were going in steps of ten, or powers of ten, and he did not like to apply that method to everything in life. He thought, in fact, that the metric system and decimalisation offered far too limited a field for the things of ordinary life. It was probably right to supplant apothecaries' weights and measures by the metric weights and measures ; but he would be sorry to see the abolition of our other useful units and the substitution for them of the mètre and its decimal derivatives. In the countries where the mètre had been used for many years the people had been struggling against it all the time, and in many cases they maintained their old weights. In fact, experience showed that the units of the metric system were not at all serviceable. He admitted that he found great advantages in his own particular line of business ; his criticism was directed to the application of metric decimalisation to a wider field than that.

Professor Silvanus P. Thompson

wished to say a word on the educational aspect of the question. A suggestion was made that children should be taught the metric system, and it was even stated that they must be instructed in decimals before they learnt vulgar fractions. As a matter of fact, our workmen, who were no longer children, found it in many cases extremely difficult to understand even the simplest idea of a decimal. Those '' points,'' which puzzled the Chancellor of the Exchequer, puzzled hundreds of workmen every day. Mr. Siemens told them that the Germans found no difficulty after the first few days in dropping into the metric system. The Germans,

however, had already learnt decimals in their coinage. If one had a decimal coinage, the people would be compelled to think in decimals from the first day they thought about money values at all, but if they did not begin to reckon cost in tenths, it would be very hard for them to rekon anything else in tenths. . . . But they would not get the common people to understand the thing until they had a decimal coinage, and there came the greatest difficulty. The coinage was decimal down to a certain point. The florin was one-tenth of a pound. But if they altered the quantity in value of the copper coinage, they had to encounter the difficulty that the common people would not understand the relation of the new coins to the old, because they thought in pence and not in shillings and pounds. If they kept the old penny, and had a new pound of the value of 1,000 farthings instead of 960, they were altering the position of the silver standard as well. The shilling was no longer a shilling ; the florin was no longer a florin ; and the English £, which had a standard value all over the world, would be tampered with. That would be a disaster. They must choose between the two alternatives of changing the value of the pound to make it a decimal multiple of the farthing, or of changing the value of the farthing to make it a decimal sub-multiple of the pound. One change interfered with international trade relations, the other interfered with the habitual unit of the proletariat.* One or other change must be made. Until they had settled that difficulty in the coinage, and made up their mind which end to begin at, he was afraid they would not agree on any decimal system whatever ; and they would not get people as a whole to agree to the introduction of decimalised weights and measures until they had learned to think values in tenths.

LORD COLCHESTER.

Speech in the House of Lords, February 23rd, 1904.

As I am one of the only few survivors, if any, of the Standards Commission of 1870 which went fully into this question, I would venture to ask whether the time has really come for taking the very much larger step proposed by the noble Lord. This is a measure which will not only effect one class of business or one class of traders—it is a measure which will affect the daily life of almost everyone. The metric system has been made permissive, and the only question is whether the time has come for making it absolutely compulsory. I recognise all the argu-

* *The reader will note that the difficulties of Decimal Coinage referred to by Professor Thompson are completely overcome by the Norms pence system.*

ments in its favour as regards the conduct of business on a large scale, especially foreign trade ; but I doubt whether it would be wise, at the present moment, to sweep away entirely the existing law and enforce the use of the metric system alike upon those who find it convenient and those who do not. We have to consider the 45 per cent. of our trade with countries where the metric system is not yet adopted ; for whatever disadvantage we are placed at with regard to countries using the metric system, yet with regard to 45 per cent. of our trade we have the advantage over our competitors who use the metric system. I think those advantages largely compensate us for the disadvantages we experience in regard to the other 55 per cent. There is, at any rate, only a slight balance of disadvantage. We have to consider those engaged in small transactions as well as those engaged in large ones, and the question is whether we should force this system upon those who have very little or nothing to do with foreign trade or with countries where the metric system is in use. Those who wish to use the metric system in order to facilitate their business are quite entitled to do so. The noble Lord stated that when once this system was introduced it would be very easy to displace local weights which are of no legal value ; but I venture to think, from the experience of France and some parts of the United States, where the *livre* as a measure and the sou as a price are still in use, where strange fractional prices continue as equivalents of those under the old system, that the adoption of the metric system will not be so easy as the noble Lord imagines. It will be very difficult to displace existing weights or to get rid altogether of the existing system. As to the educational side of the question, I do not wish to dispute the opinions which the noble Lord quoted, of persons engaged in education, but one would have thought that it would have been advantageous for children to be taught the two systems. At present it is open to anyone who finds this a convenient method, to use the metric system, and to my mind there is no necessity to go further.

Mr. Thomas Parker, M.I.C.E., &c.

From the " Engineer " of March 4th, 1904.

There are innumerable objections to the Metric System. . . . Others object that the kilogram is too large, the gram too small for practical use, yet too large for fine use, the milligram almost useless. That whilst the units may be related by tenths in linear measure, the units for square measure must be by ratios of hundredths. That the units for cubic measure must be by ratios of thousandths. . . . The millimètre, which is the 1000th of the linear unit, needs to be frac-

tioned to $\frac{1}{2}$, $\frac{1}{4}$, one-tenth, and is not comparable either for practical use or range and simplicity of figures with the British mill, and so on. All these objections raised do not apply to the metric system of measures at all, but simply only to the operative units in use with the system derived from the mètre. In this investigation, the British inch forces itself conspicuously forward as the length which would banish the whole of these objections, if it were used as linear unit of the Metric System ; and that it would be such an improvement as would warrant English-men in substituting the British inch for the mètre, us the primary unit of the Metric System. If we compare the inch with the mètre in this capacity, we shall at once see the simplicity, greater range and effi-ciency of the inch. . . . Now these units are simply a failure so far as their arithmetical existence is concerned. They are born of necessity, and are truly a make shift combination due to the error in the choice of the mètre length ; the millimètre sets are worse. . . .

There are now nominally 450 million people who have adopted the mètre units. There are nominally 550 million people, with by far the greater commerce, using the inch. There are 850 million other people who are using other measures. The 450,000,000 have a good system with inefficient and condemned mètre units. The 550,000,000 have perfect inch units with inefficient systems. No doubt the 850,000,000 will follow, adopting the perfect units to the perfect system. That this is the right and best thing to do is plain, and it is in our hands to do, and concerns us most deeply, and the world would gain by obtaining perfect units.

AMERICANS AND THE METRIC SYSTEM.

Letter in " The Times," April 4th, 1904.

It should be of very considerable interest, and even of importance, to both friends and opponents in this country of the proposed metric system to learn that a Bill to render that system compulsory in the United States of America is meeting with organized, intelligent, and influential opposition in that undoubtedly progressive country.

This opposition takes the view that the metric system is not necessary and that it is no improvement upon the duodecimal system already in use, thus supporting the views which have been expressed in your own columns by eminent British engineers and scientists.

Amongst those who have given evidence against the American Bill is Mr. Joseph Wharton, president of the American Iron and Steel Association, who appeared in his representative capacity and showed

that not a single iron and steel manufacturing concern in the United States desired the change to be made. In the course of his evidence —which was extremely interesting and long—Mr. Wharton said the business men of America had never given any attention to the matter, as they looked upon it as being one of the harmless vagaries of the professors. Another witness was Mr. L. D. Burlingame, of the celebrated Brown and Sharpe Manufacturing Company, Providence, R.I.—a concern which has a world-wide reputation for its machine tools, instruments of precision, &c. Mr. Burlingame, apart from his own interests, also appeared as the representative of the Providence Association of Mechanical Engineers, which has an influential membership amongst the chief machinery producers. Mr. Burlingame opposed the measure on the ground that it would cause great confusion in the machinery trade, by introducing a double standard, and would materially increase the cost of operating machine shops and other manufacturing plants because it would necessitate duplicate parts of machines as well as maintaining complete sets of measuring instruments graduated to both English and metric systems.

Referring to the units of the metric system, Mr. Burlingame said that there was none so convenient for machinery manufacturers as the inch. The millimètre was so small a unit that its value must be expressed for practical work in large figures ; for example, 30 inches would become 760 odd millimètres. In the matter of figuring drawings, it was his experience that the English system was quite as simple as the metric and involved fewer figures. Referring to the statements made by advocates of the metric ystem, that it was much simpler for purposes of calculation, Mr. Burlingame said he had made an effort for several months, not only with the aid of his own men, but with the assistance of the members of the Mechanical Engineers' Association, to find a problem in their line of work in which there would be a saving of time, but he had failed to find a single instance, although the draughtsmen of his company included many foreigners who were brought up on the metric system.

I venture to think that this attitude on the part of the American machinery interests and iron and steel manufacturers is of the utmost moment to our own engineers and producers. Obviously we should place ourselves at an enormous disadvantage if we were to adopt a system which our keenest and most pushing rivals can see would be so disadvantageous to themselves. We are handicapped quite sufficiently as matters now stand without adding to our burdens a system which has no practical advantages—and many serious disadvantages—over that now in universal use and understood by all the commercial people of the world.

Professor H. A. Hazen,

Of the United States Weather Bureau.
From " Nature," January 2,

The metric system usually carries with it the Centigrade scale on the thermometer, and here the whole English-speaking world should give no uncertain sound. In meteorology it would be difficult to find a worse scale than the Centigrade. The plea that we must have just 100° between the freezing and boiling points does not hold ; any convenient number of degrees would do. The Centigrade degree (1°.8 F.) is just twice too large for ordinary studies. The worst difficulty, however, is in the use of the Centigrade scale below freezing. Any one who has to study figures half of which have *minus* signs before them knows the amount of labour involved. To average a column of 30 figures half of which are *minus* takes nearly double time that figures all on one side would take, and the liability to error is more than twice as great. I have found scores of errors in foreign publications where the Centigrade scale was employed, all due to this most inconvenient *minus* sign. If any one ever gets a ' bee in his bonnet ' on this subject and desires to make the change on general principles it is very much to be hoped that he will write down a column of 30 figures half below 32° F., then convert them to the Centigrade scale, and try to average them. I am sure no English meteorologist who has ever used the Centigrade scale will ever desire to touch it.

The Late Herbert Spencer.

From a pamphlet " Against the Metric System," 3rd Edition,
1904.

I fancy conservatism will be too strong for you in another case—that of the compass. The divisions of this are, like many other sets of divisions, made by halving and re-halving and again halving, until 32 points are obtained. Is it that the habits of sailors are so fixed as to make hopeless the adoption of decimal divisions ?

Another reason has prevented—the natural relations of the cardinal points. The intervals included between them are necessarily four right angles, and this precludes a division into tenths.

Exactly. Here, as before, Nature is against you. The quadrant results from space-relations which are unchangeable and necessarily impose, in this as in other cases, division into quarters. Nature's lead

has been followed by mankind in various ways. Beyond the quarter of a year we have the moon's four quarters. The quarter of an hour is a familiar division, and so is the quarter of a mile. Then there are the quartern loaf, and the quarter of a hundredweight. Though the yard is divided into feet and inches, yet in every draper's shop yards are measured out in halves, quarters, eighths, and sixteenths or nails. Then we have a wine merchant's quarter-cask, we have the fourth of a gallon or quart, and, beyond that, we have for wine and beer, the quarter of a quart, or half-pint. Even that does not end the quartering of measures, for at the bar of a tavern quarterns of gin, that is quarter-pints of gin, are sold. Evidently we must have quarters. What do you do about them ? Ten will not divide by four. . . . . . .

I demur to your assertion. I have shown you that the mixed system would in large part remain. You cannot get rid of the established divisions of the circle and the points of the compass. You cannot escape from those quarters which the order of Nature in several ways forces on us. You cannot change the divisions of the year and the day and the hour. . . . . . .

The statement, coming from a man of business, has suggested to me the question—By whose advice is it that the metric system of weights measures, and values is to be adopted ? Is it by the advice of those who spend their lives in weighing and measuring and receiving payments for goods ? Is it that the men who alone are concerned in portioning out commodities of one or other kind to customers and who have every minute need for using this or that division or sub-division of weights or measures, have demanded to use the decimal system ? Far from it. I venture to say that in no case has the retail trader been consulted. There lies before me an imposing list of the countries that have followed the lead of France. It is headed '' Progress of the Metric System.'' It might fitly have been headed '' Progress of Bureaucratic Coercion.'' When fifty years after its nominal establishment in France, the metric system was made compulsory it was not because those who had to measure out commodities over the counter wished to use it but because the Government commanded them to do so ; and when it was adopted in Germany under the Bismarckian *regime*, we may be sure that the opinions of shopkeepers were not asked. Similarly elsewhere, its adoption has resulted from the official will and not from the popular will.

Why has this happened ? For an answer we must go back to the time of the French Revolution, when scientific men were entrusted with the task of forming a rational system of weights, measures, and values for universal use. The idea was a great one, and, allowing for

the fundamental defect on which I have been insisting, it was admirably carried out. As this defect does not diminish its great convenience for scientific purposes the system has been gradually adopted by scientific men all over the world : the great advantage being that measurements registered by a scientific man of one nation are without any trouble made intelligible to men of other nations. Evidently moved by the desire for human welfare at large, scientific men have been of late years urging that the metric system should be made universal, in the belief that immense advantages like those which they themselves find, will be found by all who are engaged in trade. Here comes in the error. They have identified two quite different requirements. For what purpose does the man of science use the metric system ? For processes of measurement. For what purpose is the trader to use it ? For processes of measurement *plus* processes of exchange. This additional element alters the problem essentially. It matters not to a chemist whether the volumes he specifies in cubic-centimètres or the weights he gives in grammes, are or are not easily divisible with exactness. Whether the quantities of liquids or gases which the physicist states in litres can or cannot be readily divided into aliquot parts is indifferent. And to the morphologist or microscopist who write down dimensions in sub-divisions of the mètre, the easy divisibility of the lengths he states is utterly irrelevant. But it is far otherwise with the man who all day long has to portion out commodities to customers and receive money in return. To satisfy the various wants of those multitudes whose purchases are in small quantities, he needs measures that fall into easy divisions and a coinage which facilitates calculation and the giving of change. Force him to do his business in tenths and he will inevitably be impeded. . . .

See then the strange position. The vast majority of our population consists of working people, people of narrow incomes, and the minor shopkeepers who minister to their wants. And these wants daily lead to myriads of purchases of small quantities for small sums, involving fractional divisions of measures and money—measuring transactions probably fifty times as numerous as those of the men of science and the wholesale traders put together. These two small classes, however, unfamiliar with retail buying and selling, have decided that they will be better carried on by the metric system than by the existing system. Those who have no experimental knowledge of the matter propose to regulate those who have ! The methods followed by the experienced are to be re-arranged by the inexperienced !

In a letter to me concerning certain views he had expressed, Dr. Sweet writes :—

‘‘ I am greatly interested in all questions relating to symbolism, notation, &c., which I approach from the linguistic point of view. From this point of view the notation of the French system is as bad as it can be (as in deci*gramme, dec*agramme) . . . the French system has shewn us what pitfalls to avoid. . . . The French names are a warning against schematic notation.’’

This question of nomenclature is far from being unimportant. The French names of quantities entail sundry evils which outweigh the nominal benefits of logical sequence and rational derivation.

(1) Instead of being monosyllables they are nearly all quadri-syllables, and this entails loss of time in speech and still more in writing : a retrogression ; for language is developed by the gradual abridgement of words.

(2) As Dr. Sweet’s example shows, many of the names are so much alike as inevitably to create confusion, even in speech at a little distance from the speaker, and still more in writing. When we re-member how commonly people write in such ways that only by the help of the context are many of their words legible, it is undeniable that there must in writing be a frequent confounding of such words as *decimetre* and *decilitre* and *decalitre*. Even were the initial syllables much more distinct, the likeness of the terminal syllables joined with carelessness of writing must be sure to cause misreadings. Serious mistakes, alike in scientific statements and in matters of business, are hence certain to rise.

(3) Even thought is necessarily impeded to some extent ; for when words have a common element like *metre* or *litre* or *gramme*, there is required a deliberate mental act to discriminate among the com-pounds—a brief pause to see which of the various things having that common element is intended. Let any one consider what would happen if we had no word for inch except twelfth-of-a-foot, and if all other dimensions were similarly referred to some large unit.

Inevitably then the nomenclature must hinder alike thought, speech, and writing. . . . . .

‘‘ Detail.’’ Yes, that is the word. We are to regard the forcible changing of all men’s and women’s daily habits as a detail ! . . . .

The advocates of the Metric System do not realise the enormous cost, time, and worry which the change must entail—greater in com-mercial countries than in others. To take the case of brewers, pub-

licans, and wine merchants, it is manifest that the abandonment of the millions of vessels now used in these trades—barrels, casks, bottles, tankards, &c., &c.—must involve prodigious expenditure, besides confusion and vexation. And the same must happen more or less in practically all businesses, from the large wholesale houses down to the village huxters. It will also involve a universal re-adjustment of prices. To the smaller shopkeepers the expense will be considerable, and the worry of learning the new weights and measures and re-adjusting their prices, will be little short of a calamity. Moreover, the change must inevitably cause myriads of disputes with customers, who will also have to learn the system—even the wives of labouring men.

Mr. F. Howard Collins.
Letter in " The Times," April 1, 1899.

Now the greatest makers of these lenses—the Carl Zeiss Optische Werkstätte, Jena . . . have been placed by the use of the metric system in Germany in this difficulty, that as one inch is equal to 25 millimètres, the half-inch objective should be called 12.5 mm., the quarter-inch 6.25, and the one-eigth-inch 3.125 mm. Thus necessitating, in these few objectives only, the use of six decimal figures.

How do they escape this cumbrous system ? Very simply. By discarding the decimal system, adopting the duodecimal system, and saying one inch shall be equal to 24 mm., which it is not, and saying nothing of the 25 to which it is equal. Hence all their objectives may be, and are, represented by whole numbers, 24, 12, 6, 3, &c.

The superiority of the duodecimal system over the decimal system has induced the German Optical Works to declare in practice that 25 millimètres equal 24 !

Professor W. H. Corfield.
Letter in " The Times," March 21, 1899.

I wish to corroborate Sir Frederick Bramwell's view that our systems of weights and measures have practical advantages which the decimal system has not. . . . . I remember my friend the late Professor W. K. Clifford saying that, if we could at once adopt the duodecimal system in its entirety, it might be worth while to make the change, but that it was not worth while to give up the advantage of our own systems for the sake of the uniformity of the decimal system. . . . . . I cannot regard without dismay the possibility of decimals being introduced into medical prescriptions, but, of course, this would never be done, whatever the system of notation.

The Report of the Select Committee of the House of Lords, Appointed 23rd February, 1904, to consider the Weights and Measures (Metric System) Bill.

The scope of inquiry of this Committee was very limited. It was appointed to consider the amendments of the Board of Trade to the Bill as read a second time in the House of Lords. All evidence on the general merits of the Metric System was carefully excluded ; the question of Decimal Coinage was not before it, and no evidence was taken on that subject. Only 14 witnesses in all appeared before the Committee. Four of them were Government, and two of them Railway, Officials. Two were Inspectors of Weights and Measures, and four were connected with Chambers of Agriculture, two of the last named being for, and two against, the Metric System. One witness, the Chairman of the Lancashire Farmers' Association, thought the change would cause great upheaval and confusion, and that it should be preceded by decimal coinage. And another expressed the same view in regard to coinage, and emphasised the need for the most gradual and piecemeal treatment of the subject with respect to weights and measures. I have referred (page 18) to some of the evidence given by Sir H. Jekyll and Colonel Johnston. No one can read carefully and impartially the whole of the evidence given before this Committee without becoming irresistibly convinced of the enormous practical difficulty of the adoption in this country of the Metric System pure and simple.

The upshot of the amendments was to bring into the Bill various limitations, and in that state it passed its third reading in the House of Lords. It has not yet reached the Commons ; and if the arguments in this book are in the main well-founded, its becoming law would be little less than a national calamity.

An Appendix to the Report gives a Précis of the replies received to three questions of a Foreign Office Circular of 10th November, 1899.

This Précis is most instructive, and brings into bold relief the extreme difficulty of effecting a change to the Metric System. I reproduce it at the end of this book (see Appendix, page 95).

The opinion on this question of the great thinker, philanthropist, and man of business, Mr. Andrew Carnegie, would be extremely valuable, but I can find nothing about it either in his speeches or writings.

CHAPTER V.

Decimal Weights and Measures.

If, with absolutely unfettered hands, we had to frame for a new nation a decimal system of weights and measures, we should probably begin by fixing upon the unit or standard of length. We have seen that the advantage of a "natural" standard is somewhat illusory, and that, whatever its value, we are able to obtain one and yet have our standard of what length we please. So long as it bears a definite and known ratio to the physical constant selected, there is little or no advantage in choosing any particular ratio. For example, had the French philosophers decreed that the mètre should be 1-10,936,143rd part of a quadrant of the meridian, instead of 1-10,000,000th part, the length of the mètre and of the yard would have been practically identical. Again the force of gravity at the equator is known. If then the length of the pendulum, which at the equator makes any agreed on number of oscilllations in any agreed on period of time, be taken as the unit of length, a truly international and "natural" standard would be obtained.* The number of the oscillations in the same period of time in any given latitude of a pendulum of the same length can easily be deduced therefrom, so that all nations, if the standard were lost, could easily recover it for themselves. We conclude, therefore, that in the choice of unit, the only thing to bear in mind is convenience of length for actual use.

Proceeding, we should be likely to take, for square unit, a square such that the length of each of its sides equalled the linear unit, and, for unit of volume, a cube such that the length of each of its edges equalled the linear unit.

Having gone thus far, the question would arise—shall we proceed, as is done in the Metric System, to choose our units of capacity and of weight so that they shall be DECIMALLY related to the unit of volume ?

There seems to be no reason why, in the nature of things, the most convenient units of weight and of capacity should be decimally connected with the most convenient unit of volume, nor does the practical advantage of their being so appear to be great, in fact, it is more apparent than real.

* *Sir Christopher Wren (born 1631), the architect of St. Paul's Cathedral, is generally supposed to have been the first to suggest a "natural" standard. He proposed to take the length of a pendulum which makes a complete oscillation in one second.*

If, therefore, we were beginning *de novo*, the balance might not very perceptibly incline to either side. If, however, we were decimalising the weights and measures of an old country, possessed of vast commerce and manufactures, the scale would instantly kick the beam in favour of throwing to the winds this decimal relationship.

Having reached this point, we should have to consider each of the five cases—Length, Area, Volume, Capacity, and Weight—and decide whether all the denominations of each case should be decimally related to one another. As before, there does not appear to be any reason in the nature of things why denominations decimally connected should be in other respects the most convenient that can be chosen ; and the practical advantage of so choosing is apparently not considerable. Hence, in dealing with an old country, this condition should also be cast aside.

Applying the foregoing observations to this country, we get :—

UNIT OF LENGTH. The foot.

UNIT OF AREA. The square foot.

UNIT OF VOLUME. The cubic foot.

UNIT OF CAPACITY. The gallon.

UNIT OF WEIGHT. The pound.

Since the weight of a gallon of water is 10lbs., the relation between the units of weight and of capacity is a decimal one.

That between the units of weight and volume is not so. The disadvantage of this fact is, however, practically NIL, since tables are published giving the specific gravities and the weights of various materials. For example, the table* before me gives the specific gravity of '' Thames sand '' as 1.64, and the weight of a cubic foot of it as 102 ℔s. Hence, to obtain the weight of a given quantity, the French engineer multiplies by 1.64, and the English one by 102. If the density of the material be unknown, both must proceed to weigh a definite quantity of it, and the amount of after calculation is substantially the same in both cases. No doubt the weight in cubic yards, feet and inches should be tabulated, whilst for the metric system the specific gravity suffices, whatever the units employed ; but the value in practice of this consideration is nominal rather than real. These remarks apply to the decimalisation of weights and volumes with the retention of our old units. The inference they enforce is that, so far as regards convenience of calculation, the practical benefit of a decimal relation between the units of weight and volume is very slight, if not infinitesimal.

* *Molesworth's Pocket Book of Engineering Formulae.*

We should next have to decide whether the denominations in each class shall be decimally related to one another. There seems to be no sufficient reason for such relationship, and its attainment in this country would cause great dislocation and confusion. When reckoning distances in miles, we do not think of feet ; when thinking about tons we do not speak of ounces ; and so on. Indeed, for most practical applications, we want, as in decimal coinage, 100 X's = 1 Y ; and the ratios of these X's and Y's to the X's and Y's of another set (provided it is known) is immaterial.*

Writing down the most useful denominations, we have

UNITS OF LENGTH. Inch ; foot ; yard ; fathom ; chain ; mile.

UNITS OF AREA. Sq. inch ; sq. foot ; sq. yard ; sq. chain ; acre ; sq. mile.

UNITS OF VOLUME. Cubic foot ; cubic yard.

UNITS OF CAPACITY. Drachm ; pint ; gallon.

UNITS OF WEIGHT. Grain ; ounce ; pound ; cental ; ton.

Each of these units would be decimally divided, and for such divisions, the Greek and Latin prefixes of the Metric System, with some modifications, could perhaps with advantage be applied.

The foregoing rough suggestions, which lay no claim to novelty of any kind, have been made to show that the Government of the day could, after due thought and inquiry in the manner suggested, decimalise our weights and measures without grave dislocation of our present standards, and could construct a system which, so far as ease and brevity of calculation are concerned, would be on a par with the Metric System, and which would be more nearly related to it than our present system.

The fact remains that, if the English-speaking peoples adopted the Metric System, there would virtually be but one system of weights and measures throughout the world—a grand and glorious consummation worthy of the great French nation to whom it owes its birth. All the same, whether the wiser course be to introduce the Metric System piecemeal, or to adopt some such system as that sketched above, can be decided only by interchange of views between ourselves, our Colonies, and the United States.

* *See also on this point pages* 92, 93.

CHAPTER VI.

THE COURSE OF LEGISLATION.

The consideration of this question may conveniently be divided into three parts :—

1. Should decimal coinage precede the Metric System, or the reverse ?

2. By whom should legislation be undertaken ?

3. On what lines and through what instrumentality should it be effected ?

PART I.—Should decimal coinage precede the Metric System ? The answer to this question is a most emphatic " Yes," and for the following reasons :—

(*a*). DECIMAL COINAGE is in use among all the civilised countries of the world, except the United Kingdom and some of its Colonies.

METRIC WEIGHTS AND MEASURES are NOT at present used either in this country, its Colonies, or in the United States ; in other words, the system has not yet been adopted by any of the English-speaking peoples.

In no country is the Metric System in use *without* Decimal Coinage, while Denmark, Russia, Canada and the United States have for a large number of years had Decimal Coinage *without* the Metric System.

Nor has any country introduced Metric Weights and Measures *first* and Decimal Coinage *afterwards*.

Hence to put the Metric System first is to put the cart before the horse, and such action entirely lacks historical precedent.

(*b*). On the question of coinage, WE STAND ABSOLUTELY ALONE AMONG CIVILISED NATIONS. By adopting decimal coinage, *we put ourselves into line with the rest of the world*. On the other hand, by adopting metric weights and measures, we, in order to fall in with a *part* of Europe, *deliberately put ourselves out of line with all other English-speaking peoples*. It is, therefore, a grave question whether we should be wise (apart from its difficulties and defects) to adopt the metric system *except by international agreement*. This consideration alone shows the absolute necessity of beginning with decimal coinage.

(*c*). We have seen what great practical trouble, expense, and other difficulties beset the introduction of the metric system. In view of them, of the imperfections of that system, and of the fact that by decimalising without metricising our weights and measures all the advantages (so far as regards calculation) of the metric system could be substantially attained with less than one tithe of the confusion, trouble and expense entailed by its adoption, many persons favour such decimalisation. Here again is a consideration which alone suffices to put beyond question the expediency of beginning with the coinage.

(*d*). The public at large will experience much trouble in becoming acquainted with the metric system. Five different cases have to be dealt with—Length, Area, Solidity, Capacity, and Weight—and in each of them more than one unit would probably be employed. For example, as regards weight, the units might be the gram, kilogram, and tonne (tonneau de mer). It is true that a mere shifting of the decimal point suffices for passing from one unit to any other of a similar kind ; still something remains to be learnt. Again, square measure and cubic measure do not proceed by multiplying and dividing by 10, but by 100 and 1000 respectively, a somewhat confusing characteristic of the system. Now, how stands decimal coinage ? Practically the Norms-and-Pence system needs no learning ; its use by the bulk of the community in their daily life does not require any knowledge of decimal arithmetic.* All one must know is that a gold coin (called a Norm, or what other name you please) of the value of 100 pence, and a silver one (called an Arg, or what other name you please) of the value of 10 pence, are in circulation. Once more we have come to a consideration which alone renders it highly advisable to begin with the coinage.

(*e*). The names of the weights and measures of the metric system require much consideration. The following appear to be those at present in actual use in France :—

Mètre, décimètre, centimètre, millimètre, décamètre, hectomètre, kilomètre, myriamètre, are, centiare, hectare, stère, décistère, décastère, litre, décilitre, centilitre, décalitre, hectolitre, gramme, décigramme, centigramme, milligramme, décagramme, hectogramme, kilogramme, quintal, tonneau de mer (tonnne).

In Germany and Austria, many old names continue to be used,

* *To many this statement will appear rather startling ; to some almost a paradox ; to those who have lived a long time in the United States, or other decimal coinage country, it will resemble a truism.*

as also in Holland.   In Spain the names have been made Spanish, and
in Italy Italian. The question, therefore, arises whether it would
be better to at once scientifically anglicise and shorten the French
names, or to introduce them as they are, leaving them to become modified,
as they undoubtedly would be, by the flow of time—yet another con-
sideration in favour of starting with decimal coinage.

(*f*). Decimal coinage being in all but universal use, and never having
been discarded when once introduced, we should, in adopting it, be as sure
of the rightness of the step as human beings well can be of any future
event.   But how stands it with the Metric System ?   Our kinsmen
beyond the sea, the pushing, go-a-head Americans, who have made more
material progress in the past hundred years, and displayed less prejudice
against change than any nation on earth, whilst they have had decimal
coinage for more than a century, are still without the Metric System ;
and the feeling against it remains at the present moment so strong that
immediate international action about it is impracticable—again the
finger points to decimal coinage first.

(*g*). We have shewn in other parts of this book that, whilst the
adoption of the Norms-pence system brings upon the public neither
trouble nor expense, the introduction of the Metric System means to
the bulk of the people serious outlay, dislocation of prices and great
temporary trouble and confusion—alone another sufficient reason for
beginning with decimal coinage.

(*h*).   Popular opinion enormously preponderates in favour of be-
ginning with decimal coinage.   This statement of course is itself only
an opinion, but it is a fact and not an opinion that a Committee of
the House of Commons in 1862 reported in favour of the adoption
of decimal coinage as a necessary preliminary to the adoption of the
Metric System of Weights and Measures, and that the 1868 Com-
missioners expressed the opinion that '' extensive familiarity with decimal
coinage would materially tend to facilitate the introduction of a decimal
scale of weights and measures.''*   Indeed, at a very early stage, the
need for proceeding piecemeal, and for introducing decimal coinage
FIRST, was recognised by the French people.   The following is a literal
translation of Article 9 of the law on the new weights and measures,
which is dated 7th April, 1795 :—

'' In order to render the replacement of the old measures easier
and less costly, it shall be carried out piecemeal and at different dates.
These dates shall be fixed by the national Convention as soon as the

* *See also the Extracts in Chapter I V.*

Republican measures have been manufactured in sufficient quantities, and that everything pertaining to the execution of those changes has been arranged.

The new system shall be first introduced in paper money and coins, next in linear measure or measure of length, and progressively extended to all the others.''

The more the question is examined, the clearer becomes the soundness of this view of it. Indeed, so overwhelming are the arguments in its favour that there appears to be no other side to the question.

PART 2.—By whom should legislation be undertaken ?

The answer is beyond doubt—By the Government of the day.

Surely argument on behalf of this reply is superfluous.

The Commissioners, appointed in 1868, observe in their 2nd Report, which deals with this subject, that '' Considering the great national importance of the question of the introduction of the Metric System of Weights and Measures throughout the United Kingdom, it appears to us essential that any measure for this object should be proposed to Parliament by the Executive Government.''

A more difficult, far-reaching, and important subject rarely comes before Parliament. It will more or less affect nearly every person in the United Kingdom ; upon vast numbers it will bring inconvenience and expense ; and, in the eyes of many, on wise legislation in reference to it, the future growth of our international trade largely depends. If this be not a subject for Government action, surely a Ministry becomes little more than a figure head, or a dead hero, from whom all life and soul, and strength and glory, have departed. It is, with a vengeance, not Government by the '' man in the street,'' but by the '' man in the House.'' Under this rule Cabinets would no longer serve any useful purpose ; and the resignation of a Prime Minister would cease to be an event of more than trifling significance.

No one can read with an impartial mind the history of the Metric System in France without being most forcibly impressed by two facts. One, the gigantic difficulties which in that country its introduction encountered ; the other, the much keener appreciation, displayed from the very first, of those difficulties than has been shewn in the two or three abortive attempts at legislation on the subject which have taken place in our own Parliament.

E

The following is a list of some of the numerous French decrees that have been passed on the subject :—

Aug, 1, 1793. Decree upon the uniformity and general system of weights and measures.

Aug. 24, 1793. Decree ordering issue of decimal coins—décime, 5 centimes, 1 centime—in place of the old ones—2 sous, 1 sou, 6 and 3 deniers.   (The denier was one-twelfth part of a penny).

Dec. 7, 1793. Decree ordering the use of decimal coins in place of the old ones.

April 7, 1795. Further decree in regard to the introduction of the Metric System.

Sept. 23, 1795. Decree in regard to the progressive substitution for the old ones of the new weights and measures.

July 16, 1799. Order of the Executive Directory relative to the introduction, in 12 districts, of the new measures of length.

July 29, 1799. Order of the Executive Directory prescribing the employment for liquids, in the district of the Seine, of the new measures of capacity.

Nov. 4, 1800. Decree relative to the putting into execution of the decimal system of weights and measures.

Dec. 24, 1801. Decree fixing the date for putting into force the new weights and measures in regard to soldiers' rations.

March 16,1803. Law prescribing to Notaries the use in their documents of decimal measures.

March 6, 1805. Law fixing postal fees according to metric measures.

March —, 1806. Collection of Tables for facilitating the comparison of the new system of weights and measures with the weights and measures previously in use in Paris. Published by order of the Minister of the Interior (30 pages quarto).

June 11, 1811. Regulation relating to the measurement of stones in Paris.

Feb. 12, 1812. Decree establishing the measures called '' usual.''

Feb. 21, 1816. Ministerial decree suppressing decimal fractions of weights and measures, and ordering the exclusive employment of ''usual'' weights and measures for the retail sale of all commodities and merchandise.

July 4, 1837.   Law, forbidding the use, after 1st January, 1840, of all
                   weights and measures other than those of the metric
                   system.

March 27, 1851.   Law for the more effectual repression of certain frauds
                   in the sale of merchandise.

PART 3. On what lines and through what instrumentality should
it be effected ?

The answer to the first part of this question has been indicated
to a great extent in other portions of this book.

Here I would add :—

(1). That the gradual piecemeal method of introduction, which
is illustrated by the Draft Bill on Decimal Coinage (Chapter VII.),
appears to be the only sound method of procedure.

(2). That the publication, in manner therein set forth, of an
Official Manual is an important point. In general, books on education
are best left to private skill and enterprise. The present case is an
exception. Uniformity of treatment throughout the country is almost
essential, and that end can only be obtained by an official publication.
Moreover, its aim and scope should be different from what they usually
are. The attitude of the writer should be that of the lazy student,
whose sole wish was to get through his examination, and who bewailed
the time he had lost when he found that he had passed by many more
marks than were required. In writing the Manual the aim should be to
put in *just enough but not one jot or tittle more than enough* to enable an
average person to use the system in the ordinary business of life. Books
on education are of course usually written on a much broader basis,
and private writers naturally incline to err, even on that broader basis,
by putting in too much. In fact, if all that some of them contain must
needs be learnt then indeed the introduction of decimal systems is
but a dream of Utopia.

For the above reasons it seems to be almost indispensable that
decimal system manuals for use in elementary schools should be official
publications. So far as regards the Norms-and-Pence system of Decimal
Coinage, no knowledge of decimals is required for the ordinary transac-
tions of life, but it is highly desirable that a Manual should
be issued at a low price which contains all that is necessary to be
known, but not more, by those to whom accounts are the business of
life.

(3). So far as knowledge of decimal systems is concerned, the problem will NOT be solved by postponing to a distant date the commencement of any compulsory Act. Few people will trouble to become acquainted with such systems until a short time before the date when their use becomes compulsory, whatever that date may be. If an act were now passed to come into force in 1906, knowledge of the subject would by that time be substantially as widespread as it would be by 1909, were that the year of the commencement of the Act. By such delay we should be acting like the mother who would not let her boy go into the water until he could swim. Nor will delay lessen the expense. The case is to be met rather by the insertion of clauses for the gradual step-by-step piecemeal introduction of the system, and of others giving to the Board of Trade large powers both of acceleration and of retardation of each successive step. (See Draft Bill, Chapter VII.) No one can foretell the course of events ; sometimes the path will be shorter and smoother, and at others longer and rougher, than had been expected. A short experience in the working of the first step will be a great help in treating the next, and to frame the Act so that advantage may be taken of this gradually accumulating knowledge seems to be the best way to reduce to a minimum the inconvenience of the change.

The answer to the last part of the question—through what instrumentality should it be effected ?—is, BY THE CREATION OF SPECIAL MACHINERY FOR THE PURPOSE.

We have Charity Commissioners, Lunacy Commissioners, Standard Commissioners, &c., with various administrative duties ; and Commissioners are not infrequently appointed for special purposes of inquiry, &c., and their labours often must materially help to shape the policy of the Government. Lord Rosebery's recent remark in the House of Lords*—that the difficulties could not be overcome by any number of Select Committees—appears to be absolutely well founded. The appointment of Special Commissioners by the Education Department proved a great success, and on the knowledge obtained by their inquiries the technical and secondary education policy of the Department has largely been founded. Still stronger is the need for such an appointment in the present case. Their reports, made after due inquiry, would throw a light upon the subject obtainable in no other way, while the action of the Government in securing such reports would be absolutely non-committal, and would not bind them in the least degree to subsequent action. Nevertheless, those reports would probably form the groundwork of speedy legislation.

* *February 23rd*, 1904.

I believe that a year from the appointment of Commissioners would see Decimal Coinage partially and most smoothly at work in this country. As regards weights and measures, the necessity of such an appointment seems to be self-evident. Lord Belhaven deserves most hearty thanks for his extremely able and indefatigable endeavours to arouse the country to action in the matter ; but his Bill was bald in the extreme, and perhaps could not well have been otherwise. It simply enacted (subject to Order in Council by His Majesty) that the use for all purposes of metric weights and measures should become compulsory on April 5th, 1906 ! Dire, indeed, would have been the toil, confusion, and expense had the Bill as it stood become law. Doubtless Lord Belhaven neither expected nor desired that end. He simply started the game by throwing the ball down. But how could such a momentous, intricate and far-reaching question be solved by referring this brief but most drastic Bill to a Select Committee of the House of Lords ? Various witnesses, chiefly officials of the Home Office and of the Board of Trade, appeared before it, and amendments, more or less in accordance with their evidence, were pitchforked into the Bill. With what result ?

The date of its operation is postponed till 1909 ! That is, no change in practice will take place for five years !

Land measures and weights and measures for purposes of excise and customs are excluded.

An Order in Council may fix different dates as respects weights and as respects measures for the commencement of the Act ; and also may exempt from its operation any trade or business.

Contracts in contravention of the Act (the principal amendment Lord Belhaven states) cease to be void, but the makers thereof may be fined not more than forty shillings on conviction under the Summary Jurisdiction Acts.

Here the promoters of the Bill lost their heads. As the Bill originally stood, deeds, contracts, &c., were to be void and of no effect unless made '' in terms of the metric system of weights and measures.'' A vague clause at the awful consequences of which they stood aghast. Such a Bill, however, must be sternly compulsory, or it degenerates into a farce. The noble Lords should have had the courage of their convictions, and cured the vagueness (as is done in section 19 of the Weights and Measures Act, 1878) by making it read '' according to one of the metric weights or measures *ascertained by this Act* or to some multiple or part thereof.'' For, how have they left matters by running away from their guns ? Is a public prosecutor to be appointed to pry

into businesses of all kinds, letters and other private documents, &c., in order to forthwith haul offenders before the magistrates ?   Or is this pleasing task to fall upon Inspectors of Weights and Measures, or upon the Police ?   Perhaps it is intended that the fines shall go to informers, when a nice crop of such gentry may be anticipated, except that many magistrates in their wisdom may think '' 6d., and no costs '' an adequate punishment for this terrible offence.

The Bill thus altered passed the House of Lords, but up to the present moment it has not appeared in the House of Commons, and there seems to be little chance of its introduction this Session.

Such is the feeble outcome of a private attempt (born prematurely through fright of the Pound-Mil Ogre) to grapple with one of the most difficult, intricate and momentous questions that can occupy the attention of statesmen.

The necessary and sufficient condition for wise legislation on this subject and on decimal coinage is Government action, preceded by the appointment of Special Commissioners.   Their chief duties, in regard to weights and measures, may be briefly summed up thus :—

(1) Inquiry in detail into various trades and manufactures as to the precise alterations in weights, measures, &c., which the change would necessitate ;   also as to upon whom the cost would fall.   To make suggestions for reducing such cost to a minimum ;   and further, to discover whether it would be expedient and practicable to place, in certain cases at least, a portion of the burden upon the State.

(2). Suggestion of means to prevent the rise in price, previously alluded to, of scales, weights and measures.

(3). Ascertainment of the position of the United States on this subject with the view to concerted action with that country.

(4). Investigation of the best way of meeting the difficulty in regard to adjustment of prices which the alteration of standards would of necessity involve.

(5). Consideration of what modifications, in regard to names, &c., the Metric System should undergo if adopted in this country.

(6). Discovery of the real strength, both in this country and America, of the feeling in favour of decimalising without metricising our weights and measures, and estimation of the practical value of the proposals that have been made in that direction.

The need for the appointment of such Commissioners, if the subject is to be adequately dealt with, appears to be axiomatic. I will, therefore, add only one illustration to what I have already said.

A manufacturer, in a very large way of business, of tiles for walls, floors, fireplaces, &c., informs me that to change all his dies and patterns to metric dimensions would cost him about £2,000, and that thousands of pounds worth of stock would have to be scrapped.

There have been numerous books, pamphlets, articles, debates, Select Committees of both Houses of Parliament, Royal Commissions, Deputations, Resolutions of Chambers of Commerce, Local Authorities and other public bodies, &c., on this subject. Where, I would ask, have the difficulties of the tile manufacturers been considered ? This query may also be put in regard to many other kinds of manufacture.

Here perhaps the reader may ask—if the adoption of the Metric System requires new standards of weights and measures, why make such a fuss over changing the value of the penny ? To which it may be replied :—

First, the need for changing the standards is the one great obstacle to the adoption of the Metric System ; but, in that case, we get our reward—*complete uniformity with the rest of Europe.* Changing the value of the penny is to introduce a purely gratuitous evil for which we get *no quid pro quo whatever.* Since the money standards of the decimal countries are by no means all the same, uniformity is impossible.

Secondly, change in the value of the penny would affect *everything* of small value, while change of the standards of weights and measures would naturally affect those things alone which are sold by weight or measure. Those are certainly very numerous ; nevertheless they leave a vast number of things untouched—newspapers, books, &c., wearing apparel, cutlery, crockery, furniture, machinery, in fact, most kinds of made-up goods, wages, &c.

And thirdly, the fact, that the adoption of the Metric System necessitates a change of the standards of weights and measures, is in itself a very strong argument in favour of the retention of the penny unaltered. For if in addition to the change of standards of weights and measures, we have to face the additional confusion entailed by a change in value of the penny, remote indeed is the chance of our generation witnessing Decimal Coinage and the Metric System.

Several reasons, all to our credit, can be adduced to explain why England has not been the leader of the nations on this great question ;

but that she should walk a century behind them is a remarkable phenomenon, and it becomes yet more strange when we look into the English history of the subject. For its consideration by our statesmen may said to have begun in 1824, with the motion in the House of Commons of Sir John Wrottesley for an inquiry into the applicability of the Decimal Scale to coins. The explanation lies in the Pound-Mil scheme.

Happily, however, our ablest statesmen—Mr. Balfour and Mr. Chamberlain on the one side, Lord Rosebery and Lord Spencer on the other—have declared in favour of an alteration in our present systems. Parliamentary action may, therefore, be confidently anticipated ; and if this book tends in any appreciable degree to quicken such action, I shall feel more than repaid for the labour its compilation has cost me.

DRAFT DECIMAL COINAGE BILL.

The following Bill, as previously stated (page 8) is but a rough Draft set down by way of illustration. An actual Bill would naturally be drawn by the Special Commissioner or Commissioners (page 70) after most careful inquiry in numerous directions and from various authorities, and with the aid of the Parliamentary Draftsmen. Moreover, it would obviously undergo consideration and revision by the Cabinet.

[4 EDW. 7.]   *Decimal Coinage.*

A BILL

To Amend the Laws relating to the Coinage.

WHEREAS it is expedient, for the purpose of causing money accounts and transactions to be conducted on a decimal system, to issue coins decimally related in value to one another, and to take other steps with the same object :   5

Be it therefore enacted by the King's Most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows :   10

1.   On and after the second day of January, 1905, or such other day, not being more than one year later, as the Treasury may appoint, the elementary parts of decimal fractions, that is to say, Addition, Subtraction, Multiplication, and Division, of abstract non-recurring decimals, 15 shall be taught in all public elementary schools to all scholars who have a fair knowledge of the first four rules of arithmetic ; and to all scholars who have a fair knowledge of such decimals, "The Manual of Decimal Coinage" which shall be issued by the Treasury before the second 20

Decimal Fractions and Coinage to be taught in Elementary Schools.

day of January, 1905 (or such other book as the Treasury may from time to time prescribe in lieu thereof) shall be taught, and an adequate knowledge of it be compulsory for passing the exemption standard.

5   2.   On or before the day on which the first section of this Act comes into force, the Treasury shall cause to be put on sale to the public at as low a price as possible, the Manual of Decimal Coinage mentioned in the said Section, or such other book as may have been prescribed 10 by the Treasury in lieu thereof.

Manual to be on Sale to the public.

3.   On and after the third day of July, 1905, or such other day, not being more than one year later, as the Treasury may appoint, the Mint shall issue gold coins called " Norms " of the value of 100 pence each, and silver coins 15 called " Args " of the value of 10 pence each ; and other gold and silver coins, multiples and sub-multiples of these two, shall be issued from time to time at the discretion of the Treasury, all to be of the denominations, weights, and fineness, specified in the Schedule to this Act, and 20 the standard trial plates shall be made accordingly.

Norms and Args to be issued by the Mint.

4.   The Provisions of Section 12 of The Coinage Act, 1870, shall apply to all coins issued from the Mint pursuant to this Act.

Trial of Coins.

5.   At any date after the third day of July, 1906, 25 that the Treasury may from time to time appoint, any or all of the gold and silver coins mentioned in the first Schedule to the Coinage Act, 1870, shall cease to be made or issued by the Mint, as the Treasury may from time to time direct.

Coins specified to cease to be issued.

30   6.   At any date after the third day of July, 1906, that the Treasury may from time to time appoint, any or all of the gold and silver coins mentioned in the first Schedule to the Coinage Act, 1870, shall cease to be legal tender, as the Treasury may from time to time direct.

What Coins may cease to be Legal Tender.

35   7.   On and after the third day of July, 1905, or such other day, not being more than one year later, as the Treasury may appoint, the Bank of England may give in exchange for its Bank-notes any of the gold coins specified in the Schedule to this Act.

What Coins in exchange for Bank Notes.

8. On and after the third day of July, 1905, or such other day, not being more than one year later, as the Treasury may appoint, the Bank of England shall issue Bank-notes of the value of 10 Norms, 20 Norms, 50 Norms, 100 Norms, and other multiples of a Norm, and such notes 5 respectively shall be a legal tender except by the said Bank.

9. At any date after the third day of July, 1906, that the Treasury may appoint, the Bank of England shall issue Bank-notes only of the value of 10 Norms, 20 Norms, 10 50 Norms, 100 Norms, and other multiples of a Norm, and such notes respectively shall be a legal tender except by the said Bank.

10. On and after the third day of July, 1905, or such other day, not being more than one year later, as the 15 Treasury may appoint, a tender of payment of money, if made in coins which have been issued by the Mint in ac- cordance with the provisions of this Act, and have not been called in by any proclamation made in pursuance of this Act, and have not become diminished in weight, by wear 20 or otherwise, so as to be of less weight than the current weight, that is to say, than the weight (if any) specified as the least current weight in the Schedule to this Act, or less than such weight as may be declared by any procla- mation made in pursuance of this Act, shall be a legal 25 tender,—

In the case of gold coins for a payment of any amount:

In the case of silver coins for a payment of an amount not exceeding fifty Args, but for no greater amount. 30

11. On and after the third day of July, 1905, or such other day, not being more than one year later, as the Treasury may appoint, every contract, sale, payment, bill, note, instrument, and security for money, and every transaction, dealing, matter, and thing whatever relating 35 to money, or involving the payment of or the liability to pay any money, which is made, executed, or entered into, done or had, may be made, executed, entered into, done and had according to the coins which are current and legal tender in pursuance of this Act. 40

Contracts,
etc., to be
made in
currency.

12.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint, every contract, sale, payment, bill, note, instrument, and security for money, and every 5 transaction, dealing, matter, and thing whatever relating to money, or involving the payment of or the liability to pay any money, which is made, executed, or entered into, done or had, shall be made, executed, entered into, done and had according to the coins which are current and legal 10 tender in pursuance of this Act, and not otherwise, unless the same be made, executed, entered into, done or had according to the currency of some British possession or some foreign state.

Post Office
Accounts.

13.   On and after the third day of July, 1905, or such 15 other day, not being more than three years later, as the Treasury may appoint, the Post Office shall keep all its accounts, and make all money orders, postal orders, &c., payable in terms of Norms and decimal fractions thereof, and not otherwise.

Government
Department
Accounts.

20 14.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint, all accounts shall be kept, and all payments made and received, by every Government Department in terms of Norms and decimal fractions 25 thereof, and not otherwise.

Courts of
Law
Accounts.

15.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint, the accounts of every Court of Law, Civil and Criminal, shall be kept, and all pay- 30 ments made and received by every such Court shall be in terms of Norms and decimal fractions thereof, and not otherwise.

Public Bodies
Accounts.

16.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the 35 Treasury may appoint, the accounts of all County, County Borough, Borough, District and Parish Councils, Boards of Guardians, and Public Companies, shall be kept, and all payments made and received by those bodies respectively shall be in terms of Norms and decimal fractions thereof, 40 and not otherwise.

17.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint all Banks shall keep their accounts in terms of Norms and decimal fractions thereof, and not otherwise.   5

18.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint, all demands for Customs and Excise Duties, and all rates and taxes, shall be made in terms of Norms and decimal fractions thereof, and not otherwise.   10

19.   On and after the third day of July, 1905, or such other day, not being more than three years later, as the Treasury may appoint, the value of stamps of all descriptions shall be denoted in terms of Norms and decimal fractions thereof, and not otherwise.   15

20.   The powers given to the Treasury by this Act of postponing certain sections of it may be exercised by the Treasury in respect of each section any number of times, provided that no postponement be to a later date than the latest date stated in such section.   20

21.   When, under the powers given to the Treasury by this Act, the operation of any section of it has been postponed, the date to which it has been postponed may be changed by the Treasury at its discretion to any earlier date, provided such date be subsequent to the 25 earliest date at which, according to the terms of such section, it could come into operation.

22.   It shall be lawful for His Majesty, with the advice of His Privy Council, from time to time by proclamation to do all or any of the following things, namely,   30
   (1) To determine the dimension of and design for
        any coin :
   (2) To diminish the amount of remedy allowed by the
        Schedule to this Act in the case of any coin :
   (3) To determine the weight (not being less than the 35
        weight (if any) specified in the Schedule to this
        Act) below which a coin, whether diminished in
        weight by wear or otherwise, is not to be a current
        or a legal tender ;

(4) To call in coins of any date or denomination, or any coins coined before the date in the proclamation mentioned :

(5) To revoke or alter any proclamation previously
5   made.
Every such proclamation shall come into operation on the date therein in that behalf mentioned and shall have effect as if it were enacted in this Act.

Not to British
Possessions.   10 23.   This Act shall not extend to any British possession.

24.   In this Act—
Definitions.   The expression " Norms and decimal fractions thereof," shall include the expression " Norms and Pence."

The expressions " Treasury," "the Mint," and " British
15   possessions " shall have the same meanings respectively as they have in the Coinage Act, 1870.

Short Title.   25.   This Act may be cited as '' The Decimal Coinage Act, 1904.''

Schedule.

Denomination of Coin.	Standard Weight.		Least Current Weight		Standard Fineness.	Remedy Allowance.		
	Imperial Weight. Grains.	Metric Weight. Grams.	Imperial Weight Grains.	Metric Weight. Grams.		Weight per Piece.		Millesimal Fineness.
						Imperial Grains.	Metric Grams.	
GOLD								
Five Norm								
Two Norm								
One Norm								
Half Norm								
SILVER								
Five Arg								
Two Arg								
One Arg								
Half-Arg								

N.B.—For the purpose in view, it seems unnecessary to insert figures in the above Schedule.

A MANUAL OF DECIMAL COINAGE.

The Manual for actual public and school use should be written somewhat fuller than the specimen here given, and it should of course contain numerous examples for exercise. We have written briefly in order to show how little need really be acquired in order to keep accounts of all kinds on the Norms-and-Pence system. Any one accustomed to accounts in pounds, shillings, and pence, could easily learn to do so in an hour or two, or less.

1. MONEY is reckoned in NORMS and PENCE.

A NORM is a gold coin worth 100 PENCE.

The letter '' N '' is used to denote Norms.

Thus N45 means 45 Norms ; N 207 means 207 Norms.

2. PENCE ARE DENOTED BY PUTTING A DECIMAL POINT AFTER THE NUMBER OF NORMS, AND THEN WRITING DOWN THE NUMBER OF PENCE, putting a nought first when the number of pence is not more than nine.

Thus N7.45 means 7 Norms and 45 pence ; N31.06 means 31 Norms and 6 pence ; N.31 means 31 pence ; N.40 means 40 pence ; N.07 means 7 pence.

3. SINCE 100 PENCE = ONE NORM, it follows that

ANY NUMBER OF PENCE MAY BE REGARDED AS A DECIMAL FRACTION OF A NORM.

Hence any sum of money may be viewed, according to convenience, AS SO MANY NORMS AND SO MANY PENCE, or, AS A DECIMAL FRACTION OF A NORM, or, by omitting the decimal point and reading as a whole number, AS SO MANY PENCE.

Thus N5697.32 may be read as 5697.32 Norms, or as 5697 Norms and 32 pence, or as 569,732 pence.

4.   Since .1 = .10, .2 = .20, etc., we may at pleasure write 10 pence, 20 pence, 30 pence, etc., with one place or two places of decimals.

Thus N4.50 = N4.5 ; N98.60 = N98.6.

For uniformity, it is best to always use two places of decimals.

Further, since 9 = 9.000 . . . . . (with as many noughts as we please), etc., it is plain that N304 = N304.00 ; N91 = 91.00, etc. This latter way of writing is sometimes useful.

5.   Since a farthing is one-fourth, a halfpenny one half, and three farthings, three-fourths of a penny, it follows that

$$\tfrac{1}{4}d. = N.0025; \quad \tfrac{1}{2}d. = N.0050; \quad \tfrac{3}{4}d. = N.0075.$$

Thus N14.2375 = 14 Norms and 23¾d.

Note that, similarly to the case of pence, a halfpenny may be written N.0050, or N.005.   The former way is preferable.

When desired, halfpence and farthings, whatever the sum, may be denoted in the old manner.   Thus N46.9325 = N46.93¼.

In arithmetical operations, it is nearly always best to consider everything from the decimal point of view, with frequent exceptions in favour of representing fractions of a penny as ¼d., ½d., and ¾d.

In some businesses eighths, sixteenths, and sometimes thirty-seconds and sixty-fourths have to be reckoned.   In these cases it is rarely advisable to convert into decimals.

6.   An ARG is a silver coin worth 10 PENCE.

Hence, the figure in the first place of decimals always represents SO MANY ARGS.

Thus 5.67 = 5 Norms 6 Args and 7 pence.

In reading sums of money, a number of ways are available.

For example, N3.4325 = 3.4325 Norms = 34.325 Args = 343.25 pence = 3 Norms and 43¼d. = 3 Norms 4 Args and 3¼d.

In practice, however, the reading would be NORMS AND PENCE, which is the usual way in decimal system countries.

Thus N5.42 would be read five Norms and forty-two pence, and might be paid away by giving 5 Norms (gold), 4 Args (silver), and 2 pence (copper), or by giving two pounds, five shillings, and two pence ; and of course in a great variety of other ways.

7. Every sum of money being represented by a whole number and a decimal fraction, it follows that :—

(1). To ADD together any number of sums of money, add as in decimals.

(2). To SUBTRACT any sum of money from any other sum of money, subtract as in decimals.

(3). To MULTIPLY any sum of money by any number, multiply as in decimals.

(4). To DIVIDE any sum of money by any number, divide as in decimals.

EXAMPLES.

ADDITION.

NORMS.	NORMS.	NORMS.
24.01	308.0075	$52.31\frac{1}{4}$
9.35	91.04	.40
.40	.5525	$105.00\frac{3}{4}$
315.26	1458.9250	$31.68\frac{1}{2}$
349.02	1858.5250	$189.40\frac{1}{2}$

SUBTRACTION.

NORMS.	NORMS.	NORMS.
419.01	32.4075	$984.00\frac{1}{4}$
17.56	31.5950	$37.15\frac{1}{2}$
401.45	.8125	$946.84\frac{3}{4}$

MULTIPLICATION.

$N91.04 \times 9 = N819.36$; $N.37 \times 7 = N\ 2.59$;

$N.0125 \times 12 = N.15$; $N9.34\frac{3}{4} \times 11 = N\ 102.82\frac{1}{4}$.

DIVISION.

$N4.55 \div 5 = N.91$; $N13.48 \div 4 = N3.37$;

$N19.3375 \div 7 = N2.7625$.

8.   In division, the decimals will of course not always terminate, but by taking two places, we get the division accurate to the nearest penny, and by taking four places, to the nearest farthing, the smallest coin of the realm.   For example :—

$$\text{N}39.3275 \div 11 = \text{N}3.5752 \ldots \ldots, \text{ that is N}3.5775 \text{ to the}$$
nearest farthing in excess, and N3.5750 to the nearest farthing in defect.

9.   Always bear in mind the rule of decimals that, to multiply by 10 you shift the decimal point ONE place to the RIGHT ; to multiply by 100, TWO places to the right ; and so on.

To divide by 10, you shift the decimal point ONE place to the LEFT ; to divide by 100, TWO places to the LEFT ; and so on.

10.   Plainly $25 + 25 = 50$; $25 + 50 = 75$; $25 + 75 = 100$; $50 + 50 = 100$; $50 + 75 = 125$; and $75 + 75 = 150$.   Hence, since 25, 50, and 75, are the *only* numbers used in denoting farthings and half-pence, it is easy to add up, as one column, the two decimal places which denote them.   It is frequently best, however, to retain them as vulgar fractions, and nearly always so when eighths, sixteenths, thirty-seconds, and sixty-fourths are involved.

11.   In account books, etc., a line is generally ruled, which saves the trouble of writing the decimal points thus :—

N.	d.		N.	d.		N.	d.
94	35	..	31	0575	..	32	52¼
4	35	..	89	1450	..	205	31½
2	00	..	962		..	1	04¾
104	72	..	3	40	..		27¼
		..			..		
205	42	..	1085	6025	..	239	15¾

Observe that the presence of fractions of a penny is always denoted by their being four instead of TWO (all that are required for pence) places of decimals.   Note also that accounts can always be kept, when pre-ferred, with the old manner of writing the fractions of a penny.

12.   CONVERSION OF POUNDS, SHILLINGS, AND PENCE, INTO NORMS.

RULE.   Bring to pence, leaving out halfpence and farthings (if any) ; then mark off two places of decimals ; and afterwards add 25 for a farthing, 50 for a halfpenny, and 75 for three farthings.

Example.   £31 2s. 9¾d. = 7473¾d. = N74·73¾ = N74·7375.

Of course we insert noughts when necessary. Thus 8d. = N.08 ; 2¾d. = N.0275 ; 7½d. = N.0750.

To bring pounds to Norms, multiply by 2.4 (or multiply by 12, and divide by 5).

It should be noted that any number of pounds ending in the figures 0 or 5 is an exact number of Norms.

Thus £5 = N12 ; £75 = N180 ; £290 = N696.

13.   CONVERSION OF NORMS INTO POUNDS, SHILLINGS, AND PENCE.

RULE.   Write as pence and fractions of a penny, then reduce to pounds, shillings, and pence.   Thus :

N32 = 3200 pence = £13 6s. 8d. ;

N41.3075 = 4130¾d. = £17 4s. 2¾d.

TABLE OF COINS.

GOLD.	SILVER.	BRONZE.
NORM (100d.)	HALF-ARG (5d)	FARTHING.
TWO-NORM (200d.)	ARG (10d.)	HALFPENNY.
FIVE-NORM (500d.)	TWO-ARG (20d.)	PENNY.
	FIVE-ARG (50d.)	

ONE NORM = 10 ARGS = 100 Pence ; ONE ARG = 10 Pence.

14.   The gold and silver coins at present in circulation need cause no confusion with the new decimal coins ; they may continue in use. Probably the florin, four-shilling piece, and half sovereign, would soon disappear.   The sovereign, being held in such high esteem, might remain for a very long period. Indeed, there is no reason why, if desired, it should not remain for ever, but we think that in course of time it would cease to be used. For some time it would probably be advisable to issue only two new coins—the Norm and the Arg.

It is useful to note that :—

ONE SHILLING = 1 Arg and 2 pence = 12 pence.

A FLORIN (2s.) = 2 Args and 4 pence = 24 pence.

A HALF-A-CROWN = 3 Args = 30 pence.

A FOUR SHILLING PIECE = 4 Args and 8 pence = 48 pence.

A FIVE SHILLING PIECE = 6 Args = 60 pence.

A HALF SOVEREIGN = 1 Norm and 2 Args = 12 Args = 120 pence.

A SOVEREIGN = 2 Norms and 4 Args = 24 Args = 240 pence.

FIVE POUNDS = 12 Norms ; TEN POUNDS = 24 Norms.

15. It is a most important fact that for all ordinary purposes—buying and selling, paying and receiving sums of money, &c.—the Norms-and-Pence system requires *no knowledge of decimals*. For, after all, the method is reckoning by Norms and Pence, the dot simply serving to separate the one from the other ; and. by disregarding the dot, the figures always denote so many pence. Indeed, a person, wholly ignorant of decimals, could keep on this system mercantile accounts of nearly every kind.

CHAPTER IX.

DECIMAL ARITHMETIC.

1. A fraction is a part of a whole.

Not every part of a whole can be represented arithmetically with absolute accuracy, but any part can always be denoted by a decimal fraction to any required degree of accuracy, that is to say, the error may be made less than any assigned quantity, however small.

2. *A Decimal fraction* is denoted by a point or dot (.) placed before the figures of which it is composed, thus .301 ; .0045 ; .52967 are decimal fractions.

When there is a whole number as well as a decimal fraction, it is placed before the decimal point, thus, 2.35 ; 4006.0706 ; 89.3.

The figure immediately after the decimal point is said to be in the first place of decimals, the next figure in the second place of decimals, the next in the third place of decimals, and so on.

The figure in the first place of decimals represents so many tenths.

,, ,, second ,, ,, ,, hundredths.

,, ,, third ,, ,, ,, thousandths.

And so on.

For example, consider .51.

The 5 is in the first place of decimals, and denotes five-tenths ; the 1 is in the second place, and denotes one-hundredth.

Again, take 60.0209.

The 60 represents the number 60. The o in the first place of decimals denotes no-tenths, *i.e.*, nothing ; 2 in the second place denotes two-hundredths ; o in the third place no-thousandths, *i.e.*, nothing ; and the 9 in the fourth place nine ten-thousandths.

3. The method of reading decimal fractions is best explained by writing one or two down and reading them off, thus—

.456 is read decimal (or point) four five six.

195.3012 is read one hundred and ninety-five decimal (or point) three nought one two.

10.007 is read ten decimal (or point) nought nought seven.

4.   Clearly we can add as many noughts as we please to either or both ends of a decimal fraction, or of a decimal fraction and a whole number, without altering its value.   Similarly, of course, we can take them away.

For example, .032=000.03200 ; 00.6430000= .643.

71.536 = 00071.53600 ; 013.45000 = 13.45.

We have called attention to this adding of noughts, because that is the reason why, in the division of decimals, the process may be continued indefinitely, that is to say, until the operation terminates through no remainder being left—an event which often will never happen.

As clearly we cannot, without altering its value, insert noughts between any two figures.

Thus, .37 is *not* = .307 ; 44.958 is *not* = 44.00958.

5.   When a fraction cannot be exactly denoted by taking any number of places of decimals, however large, the greater the number of places we take, the nearer is the result to the true value ; and, by taking a sufficient number, we can make the result as near the truth as we please.

For example, consider a quantity, say, of tea.   Then if 24.5 lbs. is the amount correct to one place of decimals, the error must be less than one-tenth part of a pound.   If 54.57 lbs. is the correct value to two places of decimals, then the error must be less than one-hundredth part of a pound.   If 54.576 lbs. is correct to three places of decimals, then the error must be less than one-thousandth part of a pound ; and so on.   This property of decimals is most valuable.

In most cases three places of decimals, and frequently even less, are all that need to be taken into account.

When places are left out, the usual rule is to add one to the last place retained, when the next figure is five or greater than five (*i.e.*, is a 5, 6, 7, 8, or 9) ;   and not to do so, when it is less than five (*i.e.*, is a 4, 3, 2, 1, or 0).

By this rule our result is not always correct to the number of places of decimals retained, but it always gives the nearest to the truth (sometimes in excess and sometimes in defect) that can be obtained by that number of places of decimals.

If, therefore, the error is required to be in excess, we should in **every** case add one to the last figure retained ;   if, on the other hand, it is required to be in defect, we should never add.

For example, consider 19.456931.

Then, the answer, correct to one place of decimals, is 19.4 ; to 2 places of decimals, 19.45 ; to 3 places, 19.456 ; to 4 places, 19.4569 ; and so on.

But the answer nearest to the truth with one place of decimals is 19.5 ; with 2 places of decimals 19.46 ; with 3 places, 19.457 ; with 4 places 19.4569 ; and so on.

6. TO ADD OR SUBTRACT DECIMALS, arrange them one under the other, taking care to place the decimal points exactly under one another. Then add, or subtract, precisely as if they were whole numbers.

EXAMPLES.

ADDITION.

3.456	.057	10.
10.031	.308	.005
246.7	.93004	1.78
260.187	1.29504	11.785

SUBTRACTION.

105.9043	.1542	.00886
24.3124	.037	.0079756
81.5919	.1172	.0008844

7. To multiply a decimal fraction by 10, 100, 1,000, &c., shift the decimal point one, two, or three, &c., places to the *right*.

To divide a decimal fraction by 10, 100, 1,000, &c., shift the decimal point one, two, or three, &c., places to the *left*.

EXAMPLES :—

$35.7 \times 10 = 357$; $9.034 \times 100 = 903.4$; $.0057 \times 1000 = 5.7$;
$.6 \times 100 = 60$; $35.7 \div 10 = 3.57$; $35.7 \div 100 = .357$;
$35.7 \div 1000 = .0357$.

8. TO MULTIPLY TWO DECIMALS (or a decimal and a whole number), multiply as if they were whole numbers ; then, in the result,

mark off as many decimal places as there are in both of them added together, beginning with the last figure and counting from right to left.

EXAMPLES.

.0231×.04	18.9706×7	.0231×.009
231	189706	231
4	7	9
924	1327942	2079

Answer, .000924. Ans., 132.7942. Ans., .0002079.

12.32×94	9.01×37	204.0507×6.02
1232	901	2040507
94	37	602
4928	6307	4081014
11088	2703	12243042
115808	33337	1228385214

Answer, 1158.08. Ans., 333.37. Ans., 1228.385214.

In the first example, there are in all 6 places of decimals. Therefore in the answer we put the decimal point so that there shall be six places of decimals. Notice, we add three noughts on the left, in order to make up the required number of decimal places. Whenever the result of the multiplication does not contain enough figures to make up the required number of decimal places, noughts, exactly enough to make up the deficiency are always added on the left side. In the second example, there are in all four places of decimals, so we put that number in the answer. In a similar way the decimal point is inserted in the remainder of the examples.

9. TO DIVIDE ONE DECIMAL BY ANOTHER, proceed as follows :—

First, multiply each of them by 10, or 100, or 1,000, or &c., choosing the least of those numbers that will make into a *whole number* the decimal by which you divide.

Next, divide as if they were whole numbers. If this operation terminates through no remainder being left, the thing required is done. If there be a remainder, add a nought to it, and continue the division ; then

another to the next remainder if there be one, and continue the division ; and so on, until you have obtained as many places of decimals as you desire, or no remainder is left—whichever event first happens.

The right placing of the decimal point in the quotient (*i.e.*, the result of the division) need occasion no trouble, the rule being that the decimal point is inserted as soon as it is necessary, in the course of the division, to use the figure in the first place of decimals.

<div align="center">

EXAMPLES.

</div>

$18.375 \div 7$	$.193 \div .006$	$4.2 \div .11$
No multiplication needed.	multiply by 1,000.	multiply by 100
	$193 \div 6$	$420 \div 11$
$7 \mid 18.375$	$6 \mid 193.$	$11 \mid 420.$
Ans. 2.625	Ans. 32.166 . . .	Ans. 38.1818 . . .

$$6.324 \div 3.1$$
$$\text{multiply by 10}$$
$$63.24 \div 31$$

$$31)63.24(2.04$$
$$62$$

$$\overline{}$$
$$124$$
$$124$$
$$\overline{}$$
$$. . .$$

$$.000976 \div .53$$
$$\text{multiply by 100}$$
$$.0976 \div 53$$

$$53).0976 (.00184 . . .$$
$$53$$

$$\overline{}$$
$$446$$
$$424$$
$$\overline{}$$
$$220$$
$$212$$
$$\overline{}$$
$$8$$

Note that :—

193 $=$ 193.000 . . . . (as many noughts as we please),
63.24 $=$ 63.14000 . . . .   ,,   ,,   ,,
.0976 $=$ .0976000 . . . .   ,,   ,,   ,,

By imagining noughts thus added (see preceding section No. 4), we can continue the division either until it terminates without remainder, or, if it does not terminate, until we have obtained in each case the number of decimal places we want.

DECIMAL RECKONING.

Decimal calculation means calculation by tens and powers of ten.

A power of ten is 10 multiplied by itself any number of times. Thus 100 (10×10) is the 2nd power of ten ; 1,000 (10×10×10) the 3rd power of ten ; and so on.

Clearly it is easier to multiply or divide by 10, 100, 1,000, 10,000, &c., than by other numbers ; in fact, a suitable shifting of the decimal point is all that is required to perform the operation. The reason of this simplicity is, not any peculiar merit in the number 10 itself, but because it has been adopted by all nations as the radix or base of notation, *e.g.*, 7985 means 5 units, 8 tens, 9 hundreds, and 7 thousands. Any other number might have been chosen as radix. For example, the number 12, which has the advantage of being divisible by 2, 3, 4, and 6, whereas 10 can be divided only by 2 and 5. Again, there is something to be said in favour of the number 8, which can be halved thrice without remainder. The probable cause of the universal choice of the number 10 is not far to seek. We have five fingers on each hand, making 10 in all. Had the Almighty bestowed six fingers upon us to each hand, it seems likely that our radix would have been twelve ; and, had we been created minus our thumbs, 8 might have been the chosen number. Any discussion on the point would of course be purely academical. We have mentioned it because the convenience of the frequent occurrence of the number 12* in our tables has been adduced as an argument against the decimal system for money, weights, and measures, since it would deprive us of that advantage. That fact cannot be gainsaid, and we must deplore the paucity of our fingers with whom the fault rests, but the facilities for reckoning afforded by the decimal system are so great and manifold that the consideration alluded to must be put on one side. If there has been a contest on the point, the battle was fought and won some fifty years ago by one of the ablest mathematicians of the last generation, the late Augustus de Morgan. He wittily remarked that " it is an abiding delusion of the opponent of decimals that he will suppose the decimalist to be under a contract never to use a common fraction."

When the subjects of calculation are all expressed decimally, Addition, Subtraction, Multiplication, and Division are reduced to their

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* *For example,* 12 *pence* = 1 *shilling ;* 24 (2×12) *grains* = 1 *pennyweight ;* 12 *ounces* = 1 *pound troy ;* 12 *inches* = 1 *foot ;* 3 (¼th of 12) *feet* = 1 *yard ;* 144 (12×12) *square inches* = 1 *square foot, &c.*

simplest forms.   Moreover, the last two processes, by the use of tables of logarithms, can be turned into those of addition and subtraction. And in most practical matters they can be so turned without such help by the construction of simple tables.   Ingenious rules, too, have been devised for shortening the multiplication and division of decimals, when only a certain number of places of decimals require to be taken into account.   For such approximate calculations, and they are exceedingly numerous in practice, decimals lend themselves in a wonderful manner.   Again, CALCULATING MACHINES are now considerably developed, and the addition, subtraction, multiplication, and division of decimals, are completely within their grasp.   Our present systems greatly impede the use of such machines.

In the 20th century, however, it is pure waste of time to labour this point.   Persons, if such there be, who are disposed to dispute the value of decimal coinage, would do well to begin by answering the following questions.   Why have all the civilised nations of the world adopted it, excepting this country and a portion of our Colonies ?   And why has no nation, once having introduced it, ever discarded it ?

In purely decimal reckoning, each denomination is ten times, or one-tenth, as large (according to the direction of motion) as the next one to it.

For example, take a fancy case.   Suppose a *Cop* is a certain quantity of anything which admits of definite numerical estimate, and that

<p align="center">10 Cops = 1 Yat ; 10 Yats = 1 Pik ; 10 Piks = 1 Tal.</p>

Consider any quantity of Piks, say, 95.34 Piks

<p align="center">Then the 5 represents 5 Piks.</p>
<p align="center">,,   ,,   9   ,,   9 Tals.</p>
<p align="center">,,   ,,   3   ,,   3 Yats.</p>
<p align="center">,,   ,,   4   ,,   4 Cops.</p>

And   9.534 Tals = 95.34 Piks = 953.4 Yats = 9534 Cops.

Thus to go from any one denomination to any other, we merely have to shift the decimal point.   The unit chosen will depend upon the quantity to be dealt with ; if that be very large, *Tals* would be most convenient ; if very small, *Yats*.

Just as in decimal coinage, two denominations usually suffice for all practical purposes.   For example, if 100 Cops = 1 Tal, then (say) Tals 65.32 may be considered as 65 Tals and 32 Cops, or as sixty-five decimal (or point) three two Tals.   And fractions of a Cop, such as one-half, fourth, eighth, sixteenth, &c., or as one-third, ninth, &c., may

be conveniently represented as vulgar fractions. Thus : Tals $65.32\frac{1}{8}=$ 65 Tals and $32\frac{1}{8}$ Cops ; Tals $4.03\frac{1}{3} = 4$ Tals and $3\frac{1}{3}$ Cops, &c.

We can thus to a great extent combine the advantages of decimals with the more extended power of division into parts which vulgar fractions offer.

Again, suppose 100 Kips = 1 Lug, where Kips and Lugs represent the same KIND of quantities as do Tals and Cops. And further, suppose that in business A, Kips and Lugs are used, while the reckoning is not on decimal lines in business B.

Then the latter business can be put on such lines without great dislocation of standards, since the most useful old unit, whatever it be, can be retained. Suppose it is a Cop, and let 100 Cops = 1 Tal. Thus business B becomes on a decimal basis, and the change has been effected without disturbance in the least degree of the mode of reckoning in business A.

The practical advantage of Lugs and Tals being decimally related to one another is usually very small, and to make them so would in general involve dislocation of standards. Indeed, the truth of the late Sir George Airy's view (pp. 27, 28) seems to be indisputable :—" It is very little important whether the relation between the standards adopted for the different measures (for instance, between the mile and the yard) be or be not simple, provided that it be ascertained."

The conclusion to be drawn, since our imaginary Cops, &c., may denote money, weight, or measure, is that our weights and measures may be DECIMALISED without great dislocation, and a system produced which is practically equal, if not superior, to the Metric System. Whether or not it is worth while, and if it be, under what conditions, to face, for the sake of uniformity with the major and by far the most important part of Europe, the herculean task of adopting the Metric System, other portions of this book will help the reader to determine.

APPENDIX.

Question No. 1, '' The ease or difficulty which the change of systems was made, the manner of introduction of the Metric System, and the time occupied in making the change.''

COUNTRY.	Date of first Introduction.	Period for Compulsory Adoption. (a) Nominal. (b) Actual.	REMARKS.
Austria - -	1871	(a) 4 years - - (a) 4 years - -	If old measures were still in use after the four years in some places, this was due to laxity of local authorities, and not to public objections to the system.
Hungary -	1875	(a) 6 months -	Old measures used for long after 1876 in certain districts, and in isolated places still in use.
Belgium -	1816	(a) 3½ years - (b) 39 years -	Original law not rigidly enforced.
Bulgaria -	1888	(a) 3 years - -	Change not yet thoroughly carried out.
Denmark -		——	Metric system not adopted, but is used in Reports on State Railways and in statistics
France - -	1793	(a) 1 year - - (b) 47 years -	Original law not rigidly applied. In 1812 use of old measures, &c., recognised. In 1837 metric system made compulsory in two and a half years.
Germany -	1868	(a) 3½ years -	Old measures of length and surface still largely used. The fact that the Zollverein pound was equal to half kilo facilitated introduction, as also did the facts that the different States had widely different weights and measures, and the period covered by the change synchronised with great political changes.
Greece - -	1836	——	Not compulsory. Tried by the Government for some purposes, but not by traders.
Italy - - -	Varied in different parts from 1845 to 1870.	——	In Southern Italy the change is still incomplete. In Northern Italy the adoption of the metric system was relatively easy ; the change having been welcomed in parts as a visible sign of liberation from Austria.

PRECIS of Replies to Foreign Office Circular.—Question No. 1—*continued*.

COUNTRY.	Date of first Introduction	Period for Compulsory Adoption. (a) Nominal. (b) Actual.	REMARKS.
Netherlands -	1816	(a) 3½ years -	At the end of the period the system was not by any means generally adopted, and is not now in all respects universally applied.
Portugal -	1852	(a) 10 years - (b) 19 years -	Delay attributed to ignorance of people. In provincial districts 75 per cent. of population still unable to read or write.
Russia - -	—	——	Metric system not adopted, except in Finland where it was brought into use after a period of two years for preparation.
Servia - -	1873	(a) 6 years - - (b) 10 years -	——
Spain - -	1849	(a) 3½ years - (b) 19½ years -	Delay due to passive resistance. In the smaller towns the old measures are still in use, but not weights.
Sweden - -	1878	(a) 10 years -	No great difficulty experienced in the change.
Norway - -	1899	(a) 3 years - -	——
Switzerland -	1875	(a) 1½ years -	No great difficulty in the towns but less easy in the country.
Turkey - -	1886	(a) 5 years in Constantinople.	Though the old measures, &c., were confiscated, the attempt to make the use of the metric system compulsory in Constantinople failed ; and a subsequent effort to introduce the kilogramme was abandoned.
Argentina -	1863 (optional) 1887 (compulsory)	(a) 10 years -	——
Brazil - -	—	——	Metric system adopted without difficulty more than 20 years ago ; some old measures, &c., still in partial use.

COUNTRY.	Date of first Introduction.	Period for Compulsory Adoption. (a) Nominal. (b) Actual.	REMARKS.
Egypt - -	1873	——	Decree of 1873 not enforced. System adopted for Government Departments in 1892 except for measurement of land and tonnage of ships. The trade of the country is carried on in old measures, &c.
Japan - -	—	——	Metric system legalised in 1903, but not in use.
Mexico - -	1862 (optional) 1895 (compulsory)	(a) 15 months -	Old measures, &c., still in partial use, but will shortly disappear.
United States	1866 (optional)	——	Metric system not used to any extent for trade.

The second and third questions were :—

(2) How far the Metric System is satisfactory in its practical operation, and whether there is any desire to return to former systems.

(3) As to the effect the adoption of the Metric System has had upon the commerce of the nations adopting it.

As to (2) the reply is universal from countries where the use of the system has really been introduced that there is *no* desire to revert to old systems.

As to (3) the replies are rather vague. The general effect is that in countries where there were great varieties of measures, &c., in use in different localities the adoption of the Metric System facilitated internal trade, and it was also beneficial to trade with other countries using the Metric System.

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